PROPERTIES

OF

STEEL SECTIONS

A REFERENCE BOOK FOR

STRUCTURAL ENGINEERS AND ARCHITECTS

INCLUDING TABLES OF MOMENTS OF INERTIA AND RADII OF GYRATION OF BUILT SECTIONS, EXAMPLES OF SECTIONS SELECTED FROM MONUMENTAL STRUCTURES, UNIT STRESSES, SAFE LOADS FOR COLUMNS, PLATE GIRDER DESIGN, DESIGN IN TIMBER, ETC., WITH ONLY SUFFICIENT TEXT TO EXPLAIN THEIR APPLICATION

BY

JOHN C. SAMPLE, C.E., M. ARCH.

Architectural Engineer, New York

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PREFACE

THERE is a tendency at the present time to call for designs to be submitted on short notice. Should the design be properly made, it requires rapid and often laborious calculations. It is hoped the designer will be able to select directly from the tables here given such sections as will meet his special requirements, thus saving the energy ordinarily spent in preliminary figuring for more important parts of design.

A portion of the material here presented was originally prepared for the author's own use as designer for a structural steel plant. When it was decided to publish the tables additional sections were included. The aim has been to cover the particular field as thoroughly as possible without producing too large a volume. It has not been considered to be within the scope of this book to treat the subjects involved from a theoretical standpoint, only sufficient text being presented to explain the application of the tables.

All values have been calculated and checked independently, and may be relied upon as correct.

Sufficient time has been taken in preparing these tables to permit the author to add such sections as are in use. He has aimed to confine himself to those sections which are necessary to good design and such shapes as are carried in stock by most large structural steel plants, it being the desire to avoid unnecessary refinements.

Common usage will account for the appearance of some of these sections.

Properties of patented sections are omitted. They may be obtained by applying to the manufacturer.

Where possible all controverted points have been avoided. There is a diversity of practice as to how much the back to back of angles should exceed the width of the plate for plate girders and columns, the practice being about equally divided between ¼″ and ½″. The author has used ¼″ for all sections with less than 42″ plates, since this is on the safe side for those using ½″. Where cover plates are not used, it is unnecessary to chip the web plate, and it is seldom necessary to chip where cover plates are used unless it be for very long web plates.

It is not intended to recommend any particular set of specifications, or to present a text on design in steel. With the exception of the chapter giving safe loads of columns, the material is general and capable of being applied to any specification.

The author acknowledges his gratitude to those who have assisted him in providing material for the chapter on Monumental Structures, pages 56 to 66. He will appreciate suggestions tending to add to the value of future editions of the book. Chapters will be revised at intervals determined by the advance in the particular subject.

Special acknowledgment is due Mr. H. R. Bradley for carefully checking all the material.

CONTENTS

General Notes Governing Tables

THE shapes used in the tables throughout are manufactured by the Carnegie Steel Co. as given in the Pocket Companion for 1903. It has been the object to supplement the Pocket Companion and not to include any information given in it.

The values of all sections except for net values of beams, channels, and cover plates, pages 94–96; net sections of angles, pages 91–93; and plate girders, pages 97–109, are based upon their gross area. Should it be required to use net sections in other cases, due allowance must be made for deductions by rivet holes.

The following notation is used throughout :

Areas of sections are square inches in cross-section.
Weights of sections are pounds per lineal foot.
Dimensions are in inches unless noted.

L = unsupported or unbraced length in feet.
l = unsupported or unbraced length in inches.
x = unknown distance in feet to point in question.
w = uniform load in pounds per lineal foot of span.
W = total load in pounds.
P = safe stress in pounds per square inch.
B = bending moment in inch pounds.
R = extreme fiber stress in pounds per square inch.
b = thickness in inches.
h = depth in inches.
A = total area of cross-section in square inches.
I = moment of inertia.
M_r = moment of resistance in inch pounds.
r = radius of gyration in inches.
e = distance in inches of extreme fiber from neutral axis.
b. to b. = back to back in inches.
C = coefficient of strength for fiber stress of 16,000 pounds per square inch.
S = section modulus.
S and C are with neutral axis perpendicular to web at center.

MOMENTS OF INERTIA AND RADII OF GYRATION OF COLUMNS AND STRUTS

THE values of all sections in this chapter are based on the gross sections, no deductions being made for rivet holes. Bending produces tension in one side of a column and increases the compression in the other, but the tension is only sufficient to reduce the compression, or in rare cases to produce a slight tension. Should such a case be possible that tension determines the section, where the member has a strut action it would be necessary to use the net values of the section.

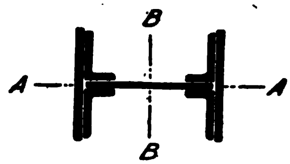
A column of such proportions should be selected as to be of nearly the same strength about both axes for the particular loading and bracing. Such relative values of l, r, and I should be examined as will show the column weakest.

The application of the tables of Moments of Inertia and Radii of Gyration is shown by the following examples. The sections will be determined in accordance with the requirements of the New York Building Law. The allowable strain in pounds per square inch for compression members, $P = 15{,}200 - 58\frac{l}{r}$. The ratio of $\frac{l}{r}$ must not exceed 120.

In each example the unsupported length about both axes is 20 feet. To this maximum ratio of $\frac{l}{r} = 120$, corresponds the minimum value of $r = \frac{l}{120} = \frac{20 \times 12}{120} = 2.0$. The minimum value of r may therefore be determined for this ratio of $\frac{l}{r}$ by pointing off one decimal place in the value of l in feet. By examination of the tables it is seen that a large number of sections have a value of r equal to or greater than 2.0 The sections used in the examples have values of r much greater than 2.0, and it is important to select such sections as will give the greatest value of r for a given area, provided the requirements or conditions will permit the use of such a section.

Let A = required area of column in square inches.
W = total direct load in pounds.
B = bending moment in inch pounds.
P = safe load in pounds per square inch.
e = distance in inches from the neutral axis to the extreme fiber on the side in which the bending produces compression.

The values of compound sections may be found by combining the values of elementary parts. This is illustrated by a column shown in the accompanying figure, the values of which are tabulated below. The column is composed of four angles $6 \times 4 \times \frac{5}{8}$, $18\frac{1}{4}''$ *b.* to *b.*, long legs outstanding, an $18'' \times \frac{1}{2}''$ web plate, and two $14'' \times \frac{5}{8}''$ cover plates.



SECTION.	AREA.	TABLE.	I ABOUT AXIS AA.	TABLE.	I ABOUT AXIS BB.
4 ∟s $6 \times 4 \times \frac{5}{8}$	**23.44**	6	206.13	9	1,566.08
1 Pl. $18'' \times \frac{1}{2}''$	**9.00**	12	.19	13	243.00
2 Pls. $14'' \times \frac{5}{8}''$	**17.50**	13	285.84	14	1,559.23
Totals	**49.94**		492.16		3,368.31
$r = \sqrt{\frac{I}{A}} =$			$\sqrt{\frac{492.16}{49.94}} = 3.14$		$\sqrt{\frac{3368.31}{49.94}} = 8.21.$

The safe direct load for this column according to the New York Building Law for an unbraced length of 20 feet is

$$W = A\left(15{,}200 - 58\frac{l}{r}\right) = 49.94\left(15{,}200 - 58\frac{240}{3.14}\right) = 537{,}700 \text{ pounds.}$$

General form of Example 1. This form is for direct loading only, *i.e.* the loading is balanced about any horizontal axis through the center of gravity of the column. This is a general case and applicable to all sections. The form becomes

$$A = \frac{W}{P} = \frac{W}{15{,}200 - 58\frac{l}{r}}.$$

General form of Example 2. This form is for combined direct load with eccentric loading or bending. This is a general case and is applicable to all sections. The form becomes

$$A = \frac{W}{\left(15{,}200 - 58\frac{l}{r}\right) - \frac{Be}{I}}.*$$

Example 1. Required a channel column capable of carrying a direct or balanced load of 230,000 pounds. To obtain the approximate area required, assume an allowable strain of 12,000 pounds per square inch. 230,000 ÷ 12,000 = 19.2 square inches. From the table 23 the area of two 10″ 15-pound channels and two 12″ × ½″ plates = 20.92; the least r = 3.68. Applying the general form,

$$A = \frac{W}{15{,}200 - 58\frac{l}{r}} = \frac{230{,}000}{15{,}200 - 58\frac{240}{3.68}} = \frac{230{,}000}{11{,}400} = 20.2.$$

The section assumed has an excessive area of .72 square inch, and is capable of being reduced by approximately that amount.

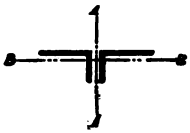
Example 2. Required a channel column capable of carrying a balanced load of 200,000 pounds, and having in addition a bending of 120,000 inch pounds. To obtain the approximate area required, assume an allowable extreme fiber strain of 10,000 pounds per square inch for the direct load. 200,000 ÷ 10,000 = 20.0 square inches. From the table 23 the area of two 10″ 15-pound channels and two 12″ × ½″ plates = 20.92; the least r = 3.68. Turn the column so it will most effectively resist the bending, by placing the axis AA parallel to the plane of bending force. The value of I about the axis AA = 464.8. Applying the general form,

$$A = \frac{W}{\left(15{,}200 - 58\frac{l}{r}\right) - \frac{Be}{I}} = \frac{200{,}000}{\left(15{,}200 - 58\frac{240}{3.68}\right) - \frac{120{,}000 \times 5.5}{464.8}} = \frac{200{,}000}{10{,}000} = 20.0$$

square inches required. The section assumed has an excessive area of .92 square inch and is capable of being reduced by approximately that amount.

* NOTE: — It will be seen by referring to the table of specifications under the chapter on Unit Strains that the practice varies; some add the total extreme fiber stress due to bending, while others add ¾ of the extreme fiber stress, to the direct stress.

TABLE 1



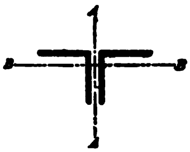
TWO ANGLES, UNEQUAL LEGS,

Size.	Total Section.		Axis BB.		Axis AA.					
					0″ b. to b.		3/8″ b. to b.		7/16″ b. to b.	
	Weight.	Area.	I	r	I	r	I	r	I	r
7×3½× ¾	49.8	14.62	12.16	.91	172.34	3.43	187.21	3.58	189.79	3.60
×11/16	46.0	13.50	11.38	.92	158.20	3.42	171.84	3.57	174.20	3.59
× 5/8	42.0	12.34	10.56	.93	143.22	3.41	155.55	3.55	157.69	3.57
×9/16	38.0	11.18	9.72	.93	129.06	3.40	140.14	3.54	142.06	3.56
× ½	34.0	10.00	8.82	.94	114.83	3.39	124.67	3.53	126.38	3.55
×7/16	30.0	8.80	7.90	.95	100.12	3.37	108.68	3.51	110.17	3.54
					0″ b. to b.		¼″ b. to b.		5/16″ b. to b.	
6×4× ¾	47.2	13.88	17.36	1.12	109.07	2.80	116.50	2.90	118.43	2.92
×11/16	43.6	12.82	16.22	1.13	100.04	2.79	106.85	2.89	108.61	2.91
× 5/8	40.0	11.72	15.04	1.13	90.44	2.78	96.57	2.87	98.16	2.89
×9/16	36.2	10.62	13.82	1.14	81.43	2.77	86.93	2.86	88.36	2.88
× ½	32.4	9.50	12.54	1.15	72.42	2.76	77.30	2.85	78.56	2.88
×7/16	28.6	8.36	11.20	1.16	63.04	2.75	67.26	2.84	68.36	2.86
× 3/8	24.6	7.22	9.80	1.17	54.11	2.74	57.73	2.83	58.67	2.85
5×3½× 5/8	33.6	9.84	9.66	.99	52.50	2.31	56.83	2.40	57.96	2.43
×9/16	30.4	8.94	8.90	1.00	47.29	2.30	51.19	2.39	52.20	2.42
× ½	27.2	8.00	8.10	1.01	42.02	2.29	45.47	2.38	46.37	2.41
×7/16	24.0	7.06	7.26	1.01	36.56	2.28	39.54	2.37	40.33	2.39
× 3/8	20.8	6.10	6.36	1.02	31.37	2.27	33.92	2.36	34.59	2.38
×5/16	17.4	5.12	5.44	1.03	26.14	2.26	28.26	2.35	28.81	2.37
4×3×9/16	24.6	7.24	5.32	.86	24.29	1.83	26.85	1.93	27.53	1.95
× ½	22.2	6.50	4.84	.86	21.60	1.82	23.86	1.92	24.46	1.94
×7/16	19.6	5.74	4.36	.87	18.74	1.81	20.70	1.90	21.21	1.92
× 3/8	17.0	4.96	3.84	.88	16.05	1.80	17.71	1.89	18.15	1.91
×5/16	14.2	4.18	3.30	.89	13.40	1.79	14.78	1.88	15.14	1.90
3×2½× ½	17.0	5.00	2.60	.72	9.16	1.35	10.49	1.45	10.84	1.47
×7/16	15.2	4.44	2.36	.73	8.02	1.34	9.18	1.44	9.49	1.46
× 3/8	13.2	3.84	2.08	.74	6.86	1.34	7.84	1.43	8.10	1.45
×5/16	11.0	3.24	1.80	.74	5.64	1.32	6.45	1.41	6.66	1.43
× ¼	9.0	2.62	1.48	.75	4.51	1.31	5.15	1.40	5.32	1.42
2½×2× 3/8	10.6	3.10	1.02	.58	3.96	1.13	4.65	1.22	4.84	1.25
×5/16	9.0	2.62	.90	.58	3.30	1.12	3.87	1.22	4.03	1.24
× ¼	7.4	2.12	.74	.59	2.62	1.11	3.07	1.20	3.20	1.23
×3/16	5.6	1.62	.58	.60	1.96	1.10	2.29	1.19	2.38	1.21

LONG LEGS OUTSTANDING

Axis AA.									
½" b. to b.		⅝" b. to b.		¾" b. to b.		⅞" b. to b.		1 b. to b.	
I	r	I	r	I	r	I	r	I	r
192.40	3.63	197.71	3.68	203.12	3.73	208.65	3.78	214.30	3.83
176.59	3.62	181.46	3.67	186.42	3.72	191.50	3.77	196.68	3.82
159.85	3.60	164.25	3.65	168.74	3.70	173.34	3.75	178.02	3.80
144.01	3.59	147.97	3.64	152.01	3.69	156.14	3.74	160.36	3.79
128.10	3.58	131.62	3.63	135.21	3.68	138.88	3.73	142.63	3.78
111.67	3.56	114.73	3.61	117.86	3.66	121.05	3.71	124.32	3.76
⅜" b. to b.		7/16" b. to b.		½" b. to b.		⅝" b. to b.		¾" b. to b.	
120.38	2.95	122.36	2.97	124.37	2.99	128.47	3.04	132.67	3.09
110.40	2.93	112.21	2.96	114.05	2.98	117.80	3.03	121.65	3.08
99.77	2.92	101.41	2.94	103.07	2.97	106.45	3.01	109.93	3.06
89.80	2.91	91.27	2.93	92.76	2.96	95.80	3.00	98.93	3.05
79.84	2.90	81.15	2.92	82.47	2.95	85.16	2.99	87.94	3.04
69.47	2.88	70.60	2.91	71.75	2.93	74.09	2.98	76.50	3.03
59.62	2.87	60.59	2.90	61.57	2.92	63.57	2.97	65.63	3.02
59.12	2.45	60.29	2.48	61.48	2.50	63.91	2.55	66.43	2.60
53.24	2.44	54.29	2.46	55.36	2.49	57.55	2.54	59.81	2.59
47.29	2.43	48.22	2.46	49.16	2.48	51.11	2.53	53.11	2.58
41.12	2.41	41.93	2.44	42.75	2.46	44.44	2.51	46.18	2.56
35.27	2.40	35.96	2.43	36.66	2.45	38.11	2.50	39.60	2.55
29.38	2.40	29.95	2.42	30.53	2.44	31.73	2.49	32.97	2.54
28.21	1.97	28.92	2.00	29.63	2.02	31.11	2.07	32.64	2.12
25.07	1.96	25.69	1.99	26.33	2.01	27.64	2.06	29.00	2.11
21.74	1.95	22.28	1.97	22.83	1.99	23.96	2.04	25.14	2.09
18.60	1.94	19.06	1.96	19.53	1.98	20.50	2.03	21.51	2.08
15.52	1.93	15.90	1.95	16.29	1.97	17.10	2.02	17.93	2.07
11.21	1.50	11.59	1.52	11.97	1.55	12.77	1.60	13.61	1.65
9.81	1.49	10.14	1.51	10.48	1.54	11.18	1.59	11.91	1.64
8.38	1.48	8.66	1.50	8.94	1.53	9.54	1.58	10.16	1.63
6.89	1.46	7.12	1.48	7.35	1.51	7.84	1.56	8.36	1.61
5.50	1.45	5.68	1.47	5.87	1.50	6.26	1.55	6.67	1.60
5.03	1.27	5.23	1.30	5.44	1.32	5.87	1.38	6.32	1.43
4.19	1.26	4.35	1.29	4.52	1.31	4.88	1.36	5.26	1.42
3.33	1.25	3.46	1.28	3.59	1.30	3.88	1.35	4.18	1.40
2.47	1.24	2.57	1.26	2.67	1.28	2.88	1.33	3.11	1.38

TABLE 2



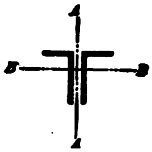
TWO ANGLES,

Size.	Total Section.		Axis BB.		Axis AA.					
					0″ b. to b.		3/8″ b. to b.		7/16″ b. to b.	
	Weight.	Area.	I	r	I	r	I	r	I	r
8×8×1	102.0	30.00	177.96	2.44	346.47	3.40	374.18	3.53	379.01	3.55
×15/16	96.0	28.24	168.66	2.44	323.29	3.38	349.06	3.52	353.55	3.54
× 7/8	90.0	26.46	159.16	2.45	301.58	3.38	325.53	3.51	329.70	3.53
×13/16	84.0	24.68	149.42	2.46	279.98	3.37	302.13	3.50	305.99	3.52
× 3/4	77.8	22.88	139.48	2.47	258.42	3.36	278.79	3.49	282.34	3.51
×11/16	71.6	21.06	129.28	2.48	235.90	3.35	254.41	3.48	257.63	3.50
× 5/8	65.4	19.22	118.84	2.49	214.42	3.34	231.17	3.47	234.09	3.49
×9/16	59.0	17.36	108.18	2.50	192.97	3.33	207.97	3.46	210.58	3.48
× 1/2	52.8	15.50	97.26	2.50	171.60	3.33	184.87	3.45	187.19	3.48
6×6× 3/4	57.4	16.88	56.30	1.83	109.78	2.55	121.64	2.68	123.73	2.71
×11/16	53.0	15.56	52.38	1.83	100.03	2.54	110.79	2.67	112.69	2.69
× 5/8	48.4	14.22	48.32	1.84	90.88	2.53	100.60	2.66	102.32	2.68
×9/16	43.8	12.86	44.14	1.85	81.74	2.52	90.44	2.65	91.98	2.67
× 1/2	39.2	11.50	39.82	1.86	72.28	2.51	79.93	2.64	81.28	2.66
×7/16	34.4	10.12	35.36	1.87	63.25	2.50	69.90	2.63	71.08	2.65
× 3/8	29.6	8.72	30.78	1.88	54.23	2.49	59.90	2.62	60.91	2.64
					0″ b. to b.		1/4″ b. to b.		5/16″ b. to b.	
4×4× 5/8	31.4	9.22	13.32	1.20	27.27	1.72	30.25	1.81	31.04	1.83
×9/16	28.6	8.36	12.24	1.21	24.48	1.71	27.14	1.80	27.84	1.83
× 1/2	25.6	7.50	11.12	1.22	21.56	1.70	23.89	1.78	24.51	1.81
×7/16	22.6	6.62	9.94	1.23	18.85	1.69	20.87	1.78	21.41	1.80
× 3/8	19.6	5.72	8.72	1.23	16.15	1.68	17.87	1.77	18.33	1.79
×5/16	16.4	4.80	7.42	1.24	13.44	1.67	14.86	1.76	15.24	1.78
3×3× 1/2	18.8	5.50	4.44	.90	9.20	1.29	10.56	1.39	10.93	1.41
×7/16	16.6	4.86	3.98	.91	8.00	1.28	9.19	1.37	9.51	1.40
× 3/8	14.4	4.22	3.52	.91	6.86	1.28	7.87	1.37	8.14	1.39
×5/16	12.2	3.56	3.02	.92	5.71	1.27	6.54	1.36	6.77	1.38
× 1/4	9.8	2.88	2.48	.93	4.51	1.25	5.16	1.34	5.34	1.36
2½×2½×7/16	13.6	4.00	2.22	.74	4.65	1.08	5.50	1.17	5.73	1.20
× 3/8	11.8	3.46	1.96	.75	3.96	1.07	4.67	1.16	4.86	1.19
×5/16	10.0	2.94	1.70	.76	3.31	1.06	3.90	1.15	4.06	1.18
× 1/4	8.2	2.38	1.40	.77	2.63	1.05	3.10	1.14	3.23	1.16
×3/16	6.2	1.80	1.10	.78	1.96	1.04	2.30	1.13	2.39	1.15
2×2×5/16	8.0	2.30	.84	.60	1.70	.86	2.08	.95	2.19	.98
× 1/4	6.4	1.88	.70	.61	1.35	.85	1.66	.94	1.75	.96
×3/16	5.0	1.44	.56	.62	1.03	.85	1.26	.93	1.32	.96

EQUAL LEGS

Axis AA.									
½″ b. to b.		⅝″ b. to b.		¾″ b. to b.		⅞″ b. to b.		1″ b. to b.	
I	r	I	r	I	r	I	r	I	r
383.89	3.58	393.83	3.62	404.01	3.67	414.42	3.72	425.07	3.76
358.10	3.56	367.35	3.61	376.82	3.65	386.52	3.70	396.43	3.75
333.93	3.55	342.53	3.60	351.34	3.64	360.36	3.69	369.58	3.74
309.90	3.54	317.86	3.59	326.02	3.63	334.37	3.68	342.91	3.73
285.93	3.54	293.26	3.58	300.76	3.63	308.44	3.67	316.31	3.72
260.91	3.52	267.57	3.56	274.40	3.61	281.39	3.66	288.55	3.70
237.05	3.51	243.08	3.56	249.27	3.60	255.60	3.65	262.08	3.69
213.24	3.50	218.64	3.55	224.18	3.59	229.86	3.64	235.67	3.68
189.54	3.50	194.33	3.54	199.24	3.59	204.27	3.63	209.42	3.68
125.86	2.73	130.21	2.78	134.69	2.82	139.30	2.87	144.05	2.92
114.62	2.71	118.57	2.76	122.64	2.81	126.84	2.86	131.15	2.90
104.07	2.71	107.64	2.75	111.33	2.80	115.13	2.85	119.03	2.89
93.54	2.70	96.74	2.74	100.04	2.79	103.45	2.84	106.95	2.88
82.66	2.68	85.48	2.73	88.38	2.77	91.38	2.82	94.47	2.87
72.28	2.67	74.73	2.72	77.27	2.76	79.88	2.81	82.58	2.86
61.93	2.66	64.02	2.71	66.18	2.75	68.41	2.80	70.71	2.85
⅜″ b. to b.		7/16″ b. to b.		½″ b. to b.		⅝″ b. to b.		¾″ b. to b.	
31.85	1.86	32.67	1.88	33.52	1.91	35.26	1.96	37.07	2.01
28.57	1.85	29.30	1.87	30.06	1.90	31.62	1.94	33.24	1.99
25.15	1.83	25.79	1.85	26.46	1.88	27.83	1.93	29.26	1.97
21.96	1.82	22.52	1.84	23.10	1.87	24.29	1.92	25.54	1.96
18.80	1.81	19.28	1.84	19.77	1.86	20.79	1.91	21.85	1.95
15.63	1 80	16.02	1.83	16.43	1.85	17.27	1.90	18.15	1.94
11.31	1.43	11.70	1.46	12.10	1.48	12.93	1.53	13.81	1.58
9.83	1.42	10.17	1.45	10.52	1.47	11.24	1.52	12.00	1.57
8.42	1.41	8.71	1.44	9.00	1.46	9.62	1.51	10.27	1.56
7.00	1.40	7.24	1.43	7.49	1.45	8.00	1.50	8.54	1.55
5.52	1.38	5.71	1.41	5.90	1.43	6.31	1.48	6.73	1.53
5.96	1.22	6.21	1.25	6.46	1.27	6.99	1.32	7.56	1.37
5.07	1.21	5.27	1.23	5.49	1.26	5.94	1.31	6.42	1.36
4.23	1.20	4.40	1.22	4.58	1.25	4.96	1.30	5.36	1.35
3.36	1.19	3.50	1.21	3.64	1.24	3.94	1.29	4.25	1.34
2.49	1.18	2.59	1.20	2.69	1.22	2.91	1.27	3.14	1.32
2.30	1.00	2.42	1.03	2.54	1.05	2.80	1.10	3.07	1.16
1.84	.99	1.93	1.01	2.03	1.04	2.23	1.09	2.45	1.14
1.39	.98	1.46	1.01	1.53	1.03	1.68	1.08	1.85	1.13

TABLE 3



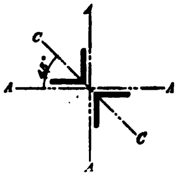
TWO ANGLES, UNEQUAL

Size.	Total Section.		Axis BB.		Axis AA.					
					0″ b. to b.		3/8″ b. to b.		7/16″ b. to b.	
	Weight.	Area.	I	r	I	r	I	r	I	r
7×3½× ¾	49.8	14.62	71.98	2.22	23.23	1.26	28.51	1.40	29.49	1.42
×11/16	46.0	13.50	66.94	2.23	21.13	1.25	25.91	1.39	26.80	1.41
× 5/8	42.0	12.34	61.72	2.24	18.86	1.24	23.09	1.37	23.87	1.39
×9/16	38.0	11.18	56.36	2.25	16.88	1.23	20.62	1.36	21.32	1.38
× ½	34.0	10.00	50.82	2.25	14.90	1.22	18.18	1.35	18.79	1.37
×7/16	30.0	8.80	45.12	2.26	12.85	1.21	15.63	1.33	16.16	1.35
					0″ b. to b.		¼″ b. to b.		5/16″ b. to b.	
6×4× ¾	47.2	13.88	49.02	1.88	33.55	1.55	37.51	1.64	38.57	1.67
×11/16	43.6	12.82	45.64	1.89	30.62	1.55	34.22	1.63	35.18	1.66
× 5/8	40.0	11.72	42.14	1.90	27.47	1.53	30.67	1.62	31.53	1.64
×9/16	36.2	10.62	38.52	1.90	24.65	1.52	27.50	1.61	28.26	1.63
× ½	32.4	9.50	34.80	1.91	21.85	1.52	24.35	1.60	25.02	1.62
×7/16	28.6	8.36	30.92	1.92	18.90	1.50	21.04	1.59	21.62	1.61
× 3/8	24.6	7.22	26.94	1.93	16.18	1.50	17.99	1.58	18.48	1.60
5×3½× 5/8	33.6	9.84	24.06	1.56	18.54	1.37	21.03	1.46	21.70	1.49
×9/16	30.4	8.94	22.06	1.57	16.63	1.36	18.85	1.45	19.45	1.47
× ½	27.2	8.00	19.98	1.58	14.72	1.36	16.67	1.44	17.19	1.47
×7/16	24.0	7.06	17.80	1.59	12.73	1.34	14.39	1.43	14.84	1.45
× 3/8	20.8	6.10	15.56	1.60	10.87	1.34	12.28	1.42	12.66	1.44
×5/16	17.4	5.12	13.20	1.61	9.05	1.33	10.21	1.41	10.52	1.43
4×3×9/16	24.6	7.24	11.10	1.24	10.55	1.21	12.20	1.30	12.65	1.32
× ½	22.2	6.50	10.10	1.25	9.32	1.20	10.77	1.29	11.16	1.31
×7/16	19.6	5.74	9.04	1.25	8.03	1.18	9.27	1.27	9.61	1.29
× 3/8	17.0	4.96	7.92	1.26	6.86	1.18	7.90	1.26	8.19	1.28
×5/16	14.2	4.18	6.76	1.27	5.71	1.17	6.57	1.25	6.81	1.28
3×2½× ½	17.0	5.00	4.16	.91	5.41	1.04	6.43	1.13	6.71	1.16
×7/16	15.2	4.44	3.76	.92	4.73	1.03	5.61	1.12	5.85	1.15
× 3/8	13.2	3.84	3.32	.93	4.02	1.02	4.76	1.11	4.96	1.14
×5/16	11.0	3.24	2.84	.94	3.30	1.01	3.90	1.10	4.07	1.12
× ¼	9.0	2.62	2.34	.95	2.62	1.00	3.09	1.09	3.23	1.11
2½×2× 3/8	10.6	3.10	1.82	.77	2.06	.82	2.56	.91	2.70	.93
×5/16	9.0	2.62	1.58	.78	1.72	.81	2.13	.90	2.24	.93
× ¼	7.4	2.12	1.30	.78	1.36	.80	1.68	.89	1.77	.91
×3/16	5.6	1.62	1.02	.79	1.00	.79	1.23	.87	1.30	.90

LEGS, SHORT LEGS OUTSTANDING

Axis AA.									
½″ b. to b.		⅝″ b. to b.		¾″ b. to b.		⅞″ b. to b.		1″ b. to b.	
I	r	I	r	I	r	I	r	I	r
30.50	1.44	32.60	1.49	34.82	1.54	37.15	1.59	39.60	1.55
27.72	1.43	29.62	1.48	31.64	1.53	33.76	1.58	35.98	1.63
24.69	1.41	26.39	1.46	28.18	1.51	30.07	1.56	32.06	1.61
22.05	1.40	23.56	1.45	25.16	1.50	26.84	1.55	28.61	1.60
19.43	1.39	20.76	1.44	22.16	1.49	23.64	1.54	25.20	1.59
16.70	1.38	17.83	1.42	19.04	1.47	20.31	1.52	21.65	1.57
⅜″ b. to b.		7/16″ b. to b.		½″ b. to b.		⅝″ b. to b.		¾″ b. to b.	
39.66	1.69	40.77	1.71	41.91	1.74	44.27	1.79	46.74	1.84
36.17	1.68	37.18	1.70	38.22	1.73	40.37	1.77	42.62	1.82
32.41	1.66	33.31	1.69	34.24	1.71	36.16	1.76	38.18	1.80
29.05	1.65	29.85	1.68	30.68	1.70	32.39	1.75	34.19	1.79
25.71	1.65	26.42	1.67	27.15	1.69	28.66	1.74	30.24	1.78
22.21	1.63	22.82	1.65	23.44	1.67	24.74	1.72	26.10	1.77
18.98	1.62	19.49	1.64	20.02	1.67	21.13	1.71	22.28	1.76
22.39	1.51	23.10	1.53	23.83	1.56	25.34	1.60	26.94	1.65
20.06	1.50	20.70	1.52	21.35	1.55	22.70	1.59	24.12	1.64
17.74	1.49	18.29	1.51	18.86	1.54	20.06	1.58	21.31	1.63
15.30	1.47	15.78	1.50	16.27	1.52	17.30	1.57	18.38	1.61
13.05	1.46	13.46	1.49	13.88	1.51	14.75	1.55	15.66	1.60
10.85	1.46	11.18	1.48	11.52	1.50	12.24	1.55	13.00	1.59
13.11	1.35	13.59	1.37	14.08	1.39	15.10	1.44	16.18	1.50
11.57	1.33	11.99	1.36	12.42	1.38	13.32	1.43	14.28	1.48
9.96	1.32	10.32	1.34	10.69	1.36	11.46	1.41	12.28	1.46
8.48	1.31	8.79	1.33	9.10	1.35	9.76	1.40	10.46	1.45
7.05	1.30	7.30	1.32	7.56	1.35	8.11	1.39	8.68	1.44
6.99	1.18	7.29	1.21	7.60	1.23	8.24	1.28	8.93	1.34
6.10	1.17	6.36	1.20	6.62	1.22	7.19	1.27	7.78	1.32
5.17	1.16	5.39	1.18	5.62	1.21	6.09	1.26	6.60	1.31
4.24	1.14	4.42	1.17	4.60	1.19	4.99	1.24	5.41	1.29
3.36	1.13	3.50	1.16	3.65	1.18	3.96	1.23	4.29	1.28
2.85	.96	3.00	.98	3.16	1.01	3.49	1.06	3.85	1.11
2.36	.95	2.49	.97	2.62	1.00	2.89	1.05	3.19	1.10
1.86	.94	1.96	.96	2.06	.99	2.28	1.04	2.51	1.09
1.37	.92	1.44	.94	1.52	.97	1.68	1.02	1.85	1.07

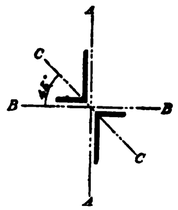
TABLE 4



STAR STRUTS

TWO ANGLES, EQUAL LEGS

Size.	Total Section.		Axis CC.		Axis AA.
	Weight.	Area.	I	r	
8×8×1	102.0	30.00	282.50	3.07	
×15/16	96.0	28.24	268.02	3.08	
× 7/8	90.0	26.46	253.14	3.09	
×13/16	84.0	24.68	237.87	3.10	For I and r about axis AA, see Table 2.
× 3/4	77.8	22.88	222.20	3.12	
×11/16	71.6	21.06	206.12	3.13	
× 5/8	65.4	19.22	189.61	3.14	
×9/16	59.0	17.36	172.69	3.15	
× 1/2	52.8	15.50	155.32	3.17	
6×6× 3/4	57.4	16.88	89.39	2.30	
×11/16	53.0	15.56	83.25	2.31	
× 5/8	48.4	14.22	76.89	2.33	
×9/16	43.8	12.86	70.31	2.34	
× 1/2	39.2	11.50	63.49	2.35	
×7/16	34.4	10.12	56.44	2.36	
× 3/8	29.6	8.72	49.14	2.37	
4×4× 5/8	31.4	9.22	21.04	1.51	
×9/16	28.6	8.36	19.40	1.52	
× 1/2	25.6	7.50	17.66	1.53	
×7/16	22.6	6.62	15.82	1.55	
× 3/8	19.6	5.72	13.89	1.56	
×5/16	16.4	4.80	11.85	1.57	
3×3× 1/2	18.8	5.50	6.99	1.13	
×7/16	16.6	4.86	6.31	1.14	
× 3/8	14.4	4.22	5.59	1.15	
×5/16	12.2	3.56	4.81	1.16	
× 1/4	9.8	2.88	3.97	1.17	
2½×2½×7/16	13.6	4.00	3.49	.93	
× 3/8	11.8	3.46	3.11	.95	
×5/16	10.0	2.94	2.69	.96	
× 1/4	8.2	2.38	2.24	.97	
×3/16	6.2	1.80	1.74	.98	
2×2×5/16	8.0	2.30	1.32	.76	
× 1/4	6.4	1.88	1.10	.77	
×3/16	5.0	1.44	.87	.78	



STAR STRUTS

TWO ANGLES, UNEQUAL LEGS

Size.	Total Section.		Axis CC.		Axes AA and BB.
	Weight.	Area.	I	r	
6×4×$\frac{5}{8}$	40.0	11.72	48.97	2.04	For I and r about axis AA, see Table 3. For I and r about axis BB, see Table 1.
×$\frac{9}{16}$	36.2	10.62	44.85	2.06	
×$\frac{1}{2}$	32.4	9.50	40.57	2.07	
×$\frac{7}{16}$	28.6	8.36	36.13	2.08	
×$\frac{3}{8}$	24.6	7.22	31.52	2.09	
4×3×$\frac{1}{2}$	22.2	6.50	12.32	1.38	
×$\frac{7}{16}$	19.6	5.74	11.07	1.39	
×$\frac{3}{8}$	17.0	4.96	9.74	1.40	
×$\frac{5}{16}$	14.2	4.18	8.33	1.41	
3×2½×$\frac{7}{16}$	15.2	4.44	4.90	1.05	
×$\frac{3}{8}$	13.2	3.84	4.35	1.06	
×$\frac{5}{16}$	11.0	3.24	3.75	1.08	
×$\frac{1}{4}$	9.0	2.62	3.10	1.09	

TABLE 6

FOUR

UNEQUAL LEGS,

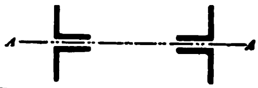
Size.	Total Section.		Axis AA.					
			3/8" b. to b.		7/16" b. to b.		1/2" b. to b.	
	Weight.	Area.	I	r	I	r	I	r
7×3½× 3/4	99.6	29.24	374.43	3.58	379.59	3.60	384.81	3.63
×11/16	92.0	27.00	343.67	3.57	348.40	3.59	353.19	3.62
× 5/8	84.0	24.68	311.10	3.55	315.38	3.57	319.71	3.60
×9/16	76.0	22.36	280.28	3.54	284.13	3.56	288.02	3.59
× 1/2	68.0	20.00	249.34	3.53	252.75	3.55	256.21	3.58
×7/16	60.0	17.60	217.36	3.51	220.33	3.54	223.34	3.56
			1/4" b. to b.		5/16" b. to b.		3/8" b. to b.	
6×4× 3/4	94.4	27.76	233.01	2.90	236.86	2.92	240.77	2.95
×11/16	87.2	25.64	213.69	2.89	217.22	2.91	220.79	2.93
× 5/8	80.0	23.44	193.14	2.87	196.31	2.89	199.54	2.92
×9/16	72.4	21.24	173.86	2.86	176.71	2.88	179.61	2.91
× 1/2	64.8	19.00	154.59	2.85	157.12	2.88	159.69	2.90
×7/16	57.2	16.72	134.53	2.84	136.72	2.86	138.95	2.88
× 3/8	49.2	14.44	115.46	2.83	117.33	2.85	119.24	2.87
5×3½× 5/8	67.2	19.68	113.67	2.40	115.93	2.43	118.23	2.45
×9/16	60.8	17.88	102.37	2.39	104.41	2.42	106.48	2.44
× 1/2	54.4	16.00	90.94	2.38	92.74	2.41	94.57	2.43
×7/16	48.0	14.12	79.09	2.37	80.65	2.39	82.24	2.41
× 3/8	41.6	12.20	67.84	2.36	69.18	2.38	70.54	2.40
×5/16	34.8	10.24	56.52	2.35	57.63	2.37	58.75	2.40
4×3×9/16	49.2	14.48	53.70	1.93	55.05	1.95	56.43	1.97
× 1/2	44.4	13.00	47.72	1.92	48.92	1.94	50.14	1.96
×7/16	39.2	11.48	41.39	1.90	42.42	1.92	43.48	1.95
× 3/8	34.0	9.92	35.42	1.89	36.30	1.91	37.20	1.94
×5/16	28.4	8.36	29.56	1.88	30.29	1.90	31.04	1.93
3×2½× 1/2	34.0	10.00	20.98	1.45	21.69	1.47	22.42	1.50
×7/16	30.4	8.88	18.36	1.44	18.98	1.46	19.62	1.49
× 3/8	26.4	7.68	15.68	1.43	16.21	1.45	16.75	1.48
×5/16	22.0	6.48	12.89	1.41	13.33	1.43	13.77	1.46
× 1/4	18.0	5.24	10.29	1.40	10.64	1.42	10.99	1.45
2½×2× 3/8	21.2	6.20	9.29	1.22	9.67	1.25	10.06	1.27
×5/16	18.0	5.24	7.74	1.22	8.05	1.24	8.37	1.26
× 1/4	14.8	4.24	6.15	1.20	6.40	1.23	6.65	1.25
×3/16	11.2	3.24	4.58	1.19	4.76	1.21	4.95	1.24

ANGLES, LACED

LONG LEGS OUTSTANDING

Axis AA.							
⅝″ b. to b.		¾″ b. to b.		⅞″ b. to b.		1″ b. to b.	
I	r	I	r	I	r	I	r
395.41	3.68	406.24	3.73	417.30	3.78	428.59	3.83
362.91	3.67	372.85	3.72	382.99	3.77	393.35	3.82
328.50	3.65	337.49	3.70	346.67	3.75	356.05	3.80
295.94	3.64	304.02	3.69	312.29	3.74	320.72	3.79
263.24	3.63	270.42	3.68	277.76	3.73	285.26	3.78
229.46	3.61	235.71	3.66	242.11	3.71	248.64	3.76
7/16″ b. to b.		½″ b. to b.		⅝″ b. to b.		¾″ b. to b.	
244.73	2.97	248.75	2.99	256.94	3.04	265.35	3.09
224.42	2.96	228.10	2.98	235.60	3.03	243.30	3.08
202.81	2.94	206.13	2.97	212.90	3.01	219.86	3.06
182.55	2.93	185.53	2.96	191.61	3.00	197.86	3.05
162.29	2.92	164.93	2.95	170.33	2.99	175.87	3.04
141.21	2.91	143.50	2.93	148.19	2.98	153.00	3.03
121.17	2.90	123.14	2.92	127.14	2.97	131.27	3.02
120.57	2.48	122.95	2.50	127.83	2.55	132.85	2.60
108.58	2.46	110.72	2.49	115.10	2.54	119.63	2.59
96.43	2.46	98.33	2.48	102.21	2.53	106.22	2.58
83.86	2.44	85.51	2.46	88.88	2.51	92.36	2.56
71.92	2.43	73.33	2.45	76.21	2.50	79.19	2.55
59.90	2.42	61.07	2.44	63.46	2.49	65.94	2.54
57.83	2.00	59.27	2.02	62.22	2.07	65.29	2.12
51.38	1.99	52.65	2.01	55.27	2.06	57.99	2.11
44.56	1.97	45.66	1.99	47.93	2.04	50.29	2.09
38.12	1.96	39.06	1.98	41.00	2.03	43.01	2.08
31.80	1.95	32.58	1.97	34.19	2.02	35.87	2.07
23.17	1.52	23.95	1.55	25.55	1.60	27.23	1.65
20.28	1.51	20.95	1.54	22.35	1.59	23.82	1.64
17.31	1.50	17.88	1.53	19.08	1.58	20.33	1.63
14.23	1.48	14.70	1.51	15.68	1.56	16.72	1.61
11.36	1.47	11.73	1.50	12.51	1.55	13.33	1.60
10.46	1.30	10.87	1.32	11.73	1.38	12.64	1.43
8.71	1.29	9.05	1.31	9.76	1.36	10.52	1.42
6.91	1.28	7.19	1.30	7.75	1.35	8.35	1.40
5.14	1.26	5.35	1.28	5.77	1.33	6.21	1.38

TABLE 7



FOUR
EQUAL

Size.	Total Section. Weight.	Total Section. Area.	Axis AA — 3/8″ b. to b. I	3/8″ b. to b. r	7/16″ b. to b. I	7/16″ b. to b. r	1/2″ b. to b. I	1/2″ b. to b. r
8×8×1	204.0	60.00	748.37	3.53	758.01	3.55	767.78	3.58
×15/16	192.0	56.48	698.13	3.52	707.10	3.54	716.19	3.56
×7/8	180.0	52.92	651.05	3.51	659.40	3.53	667.85	3.55
×13/16	168.0	49.36	604.26	3.50	611.98	3.52	619.80	3.54
×3/4	155.6	45.76	557.57	3.49	564.67	3.51	571.87	3.54
×11/16	143.2	42.12	508.81	3.48	515.27	3.50	521.81	3.52
×5/8	130.8	38.44	462.33	3.47	468.18	3.49	474.10	3.51
×9/16	118.0	34.72	415.93	3.46	421.17	3.48	426.47	3.50
×1/2	105.6	31.00	369.75	3.45	374.38	3.48	379.08	3.50
6×6×3/4	114.8	33.76	243.28	2.68	247.47	2.71	251.72	2.73
×11/16	106.0	31.12	221.58	2.67	225.38	2.69	229.24	2.71
×5/8	96.8	28.44	201.21	2.66	204.64	2.68	208.14	2.71
×9/16	87.6	25.72	180.88	2.65	183.96	2.67	187.09	2.70
×1/2	78.4	23.00	159.85	2.64	162.56	2.66	165.31	2.68
×7/16	68.8	20.24	139.80	2.63	142.16	2.65	144.56	2.67
×3/8	59.2	17.44	119.80	2.62	121.81	2.64	123.86	2.66
			1/4″ b. to b. I	1/4″ b. to b. r	5/16″ b. to b. I	5/16″ b. to b. r	3/8″ b. to b. I	3/8″ b. to b. r
4×4×5/8	62.8	18.44	60.50	1.81	62.08	1.83	63.69	1.86
×9/16	57.2	16.72	54.28	1.80	55.69	1.83	57.13	1.85
×1/2	51.2	15.00	47.79	1.78	49.02	1.81	50.29	1.83
×7/16	45.2	13.24	41.74	1.78	42.82	1.80	43.92	1.82
×3/8	39.2	11.44	35.75	1.77	36.66	1.79	37.60	1.81
×5/16	32.8	9.60	29.72	1.76	30.48	1.78	31.25	1.80
3×3×1/2	37.6	11.00	21.12	1.39	21.86	1.41	22.62	1.43
×7/16	33.2	9.72	18.37	1.37	19.01	1.40	19.67	1.42
×3/8	28.8	8.44	15.73	1.37	16.28	1.39	16.84	1.41
×5/16	24.4	7.12	13.09	1.36	13.54	1.38	14.00	1.40
×1/4	19.6	5.76	10.32	1.34	10.68	1.36	11.04	1.38
2½×2½×7/16	27.2	8.00	10.99	1.17	11.45	1.20	11.93	1.22
×3/8	23.6	6.92	9.34	1.16	9.73	1.19	10.13	1.21
×5/16	20.0	5.88	7.80	1.15	8.12	1.18	8.46	1.20
×1/4	16.4	4.76	6.20	1.14	6.45	1.16	6.72	1.19
×3/16	12.4	3.60	4.59	1.13	4.78	1.15	4.97	1.18
2×2×5/16	16.0	4.60	4.16	.95	4.38	.98	4.61	1.00
×1/4	12.8	3.76	3.32	.94	3.49	.96	3.67	.99
×3/16	10.0	2.88	2.51	.93	2.64	.96	2.77	.98

ANGLES, LACED

LEGS

Axis AA.							
$\frac{5}{8}''$ b. to b.		$\frac{3}{4}''$ b. to b.		$\frac{7}{8}''$ b. to b.		1″ b. to b.	
I	r	I	r	I	r	I	r
787.67	3.62	808.02	3.67	828.84	3.72	850.13	3.76
734.70	3.61	753.65	3.65	773.03	3.70	792.87	3.75
685.06	3.60	702.68	3.64	720.71	3.69	739.16	3.74
635.73	3.59	652.04	3.63	668.74	3.68	685.82	3.73
586.52	3.58	601.52	3.63	616.89	3.67	632.61	3.72
535.14	3.56	548.79	3.61	562.78	3.66	577.09	3.70
486.17	3.56	498.53	3.60	511.20	3.65	524.17	3.69
437.28	3.55	448.37	3.59	459.72	3.64	471.35	3.68
388.66	3.54	398.48	3.59	408.53	3.63	418.84	3.68
260.42	2.78	269.38	2.82	278.60	2.87	288.10	2.92
237.14	2.76	245.29	2.81	253.67	2.86	262.31	2.90
215.29	2.75	222.66	2.80	230.25	2.85	238.07	2.89
193.49	2.74	200.09	2.79	206.89	2.84	213.90	2.88
170.95	2.73	176.77	2.77	182.77	2.82	188.95	2.87
149.47	2.72	154.54	2.76	159.77	2.81	165.15	2.86
128.05	2.71	132.37	2.75	136.83	2.80	141.43	2.85
$\frac{7}{16}''$ b. to b.		$\frac{1}{2}''$ b. to b.		$\frac{5}{8}''$ b. to b.		$\frac{3}{4}''$ b. to b.	
65.34	1.88	67.03	1.91	70.51	1.96	74.14	2.01
58.61	1.87	60.12	1.90	63.24	1.94	66.48	1.99
51.59	1.85	52.91	1.88	55.65	1.93	58.51	1.97
45.05	1.84	46.20	1.87	48.59	1.92	51.08	1.96
38.56	1.84	39.54	1.86	41.58	1.91	43.70	1.95
32.05	1.83	32.86	1.85	34.54	1.90	36.30	1.94
23.40	1.46	24.20	1.48	25.86	1.53	27.61	1.58
20.34	1.45	21.04	1.47	22.49	1.52	24.01	1.57
17.41	1.44	18.01	1.46	19.24	1.51	20.55	1.56
14.48	1.43	14.97	1.45	16.00	1.50	17.08	1.55
11.42	1.41	11.80	1.43	12.61	1.48	13.46	1.53
12.42	1.25	12.93	1.27	13.99	1.32	15.11	1.37
10.55	1.23	10.98	1.26	11.88	1.31	12.83	1.36
8.80	1.22	9.16	1.25	9.91	1.30	10.71	1.35
6.99	1.21	7.28	1.24	7.87	1.29	8.51	1.34
5.17	1.20	5.38	1.22	5.82	1.27	6.28	1.32
4.84	1.03	5.08	1.05	5.59	1.10	6.14	1.16
3.86	1.01	4.05	1.04	4.46	1.09	4.90	1.14
2.91	1.01	3.06	1.03	3.36	1.08	3.69	1.13

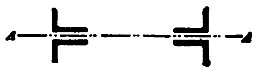


TABLE 8

FOUR ANGLES, LACED

UNEQUAL LEGS, SHORT LEGS OUTSTANDING

Size.	Total Section.		Axis AA.													
			3/8″ b. to b.		7/16″ b. to b.		1/2″ b. to b.		5/8″ b. to b.		3/4″ b. to b.		7/8″ b. to b.		1″ b. to b.	
	Weight.	Area.	I	r	I	r	I	r	I	r	I	r	I	r	I	r
7×3½× 3/4	99.6	29.24	57.02	1.40	58.98	1.42	61.00	1.44	65.21	1.49	69.64	1.54	74.31	1.59	79.20	1.65
×11/16	92.0	27.00	51.82	1.39	53.60	1.41	55.43	1.43	59.25	1.48	63.28	1.53	67.52	1.58	71.97	1.63
× 5/8	84.0	24.68	46.17	1.37	47.75	1.39	49.38	1.41	52.77	1.46	56.36	1.51	60.15	1.56	64.12	1.61
×9/16	76.0	22.36	41.24	1.36	42.65	1.38	44.09	1.40	47.11	1.45	50.31	1.50	53.68	1.55	57.23	1.60
× 1/2	68.0	20.00	36.36	1.35	37.59	1.37	38.86	1.39	41.51	1.44	44.32	1.49	47.29	1.54	50.41	1.59
×7/16	60.0	17.60	31.27	1.33	32.32	1.35	33.40	1.38	35.67	1.42	38.07	1.47	40.62	1.52	43.30	1.57
			1/4″ b. to b.		5/16″ b. to b.		3/8″ b. to b.		7/16″ b. to b.		1/2″ b. to b.		5/8″ b. to b.		3/4″ b. to b.	
6×4× 3/4	94.4	27.76	75.03	1.64	77.15	1.67	79.32	1.69	81.54	1.71	83.82	1.74	88.55	1.79	93.49	1.84
×11/16	87.2	25.64	68.44	1.63	70.37	1.66	72.34	1.68	74.36	1.70	76.44	1.73	80.74	1.77	85.24	1.82
× 5/8	80.0	23.44	61.35	1.62	63.06	1.64	64.82	1.66	66.63	1.69	68.48	1.71	72.33	1.76	76.35	1.80
×9/16	72.4	21.24	55.00	1.61	56.53	1.63	58.10	1.65	59.71	1.68	61.36	1.70	64.79	1.75	68.38	1.79
× 1/2	64.8	19.00	48.70	1.60	50.04	1.62	51.42	1.65	52.84	1.67	54.29	1.69	57.31	1.74	60.48	1.78
×7/16	57.2	16.72	42.08	1.59	43.23	1.61	44.42	1.63	45.63	1.65	46.88	1.67	49.47	1.72	52.20	1.77
× 3/8	49.2	14.44	35.98	1.58	36.95	1.60	37.96	1.62	38.99	1.64	40.05	1.67	42.25	1.71	44.57	1.76
5×3½× 5/8	67.2	19.68	42.06	1.46	43.40	1.49	44.78	1.51	46.20	1.53	47.66	1.56	50.69	1.60	53.87	1.65
×9/16	60.8	17.88	37.70	1.45	38.90	1.47	40.13	1.50	41.39	1.52	42.70	1.55	45.40	1.59	48.25	1.64
× 1/2	54.4	16.00	33.34	1.44	34.39	1.47	35.47	1.49	36.58	1.51	37.73	1.54	40.11	1.58	42.62	1.63
×7/16	48.0	14.12	28.78	1.43	29.68	1.45	30.61	1.47	31.57	1.50	32.55	1.52	34.60	1.57	36.76	1.61
× 3/8	41.6	12.20	24.56	1.42	25.32	1.44	26.11	1.46	26.92	1.49	27.75	1.51	29.49	1.55	31.33	1.60
×5/16	34.8	10.24	20.42	1.41	21.04	1.43	21.69	1.46	22.36	1.48	23.05	1.50	24.48	1.55	26.00	1.59

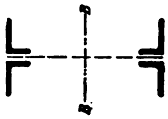


TABLE 9 (*Continued on pp.* 18 *and* 19)

FOUR ANGLES, LACED

UNEQUAL LEGS, LONG, LEGS OUTSTANDING

Size.	Total Section.		Axis BB.					
			7½″ b. to b.		8¼″ b. to b.		10¼″ b. to b.	
	Weight.	Area.	I	r	I	r	I	r
7×3½× ¾	99.6	29.24	266.85	3.02	334.12	3.38	553.71	4.35
×11/16	92.0	27.00	249.83	3.04	312.35	3.40	516.20	4.37
× ⅝	84.0	24.68	233.00	3.07	290.70	3.43	478.52	4.40
×9/16	76.0	22.36	214.03	3.09	266.64	3.45	437.70	4.42
× ½	68.0	20.00	194.06	3.12	241.42	3.47	395.22	4.45
×7/16	60.0	17.60	174.20	3.15	216.28	3.51	352.68	4.48
					8¼″ b. to b.		10¼″ b. to b.	
6×4 × ¾	94.4	27.76	. . . .	. . .	313.68	3.36	488.93	4.20
×11/16	87.2	25.64	. . . .	. . .	293.36	3.38	456.12	4.22
× ⅝	80.0	23.44	. . . .	. . .	273.12	3.41	423.15	4.25
×9/16	72.4	21.24	. . . .	. . .	250.61	3.43	387.30	4.27
× ½	64.8	19.00	. . . .	. . .	227.00	3.46	349.95	4.29
×7/16	57.2	16.72	. . . .	. . .	203.38	3.49	312.45	4.32
× ⅜	49.2	14.44	. . . .	. . .	177.81	3.51	272.51	4.34
			7½″ b. to b.		8¼″ b. to b.		10¼″ b. to b.	
5×3½× ⅝	67.2	19.68	173.61	2.97	217.71	3.33	362.35	4.29
×9/16	60.8	17.88	159.99	2.99	200.32	3.35	332.45	4.31
× ½	54.4	16.00	145.25	3.01	181.58	3.37	300.46	4.33
×7/16	48.0	14.12	130.83	3.04	163.20	3.40	268.96	4.36
× ⅜	41.6	12.20	114.62	3.07	142.77	3.42	234.64	4.39
×5/16	34.8	10.24	97.59	3.09	121.38	3.44	198.90	4.41
			6½″ b. to b.		8¼″ b. to b.		10¼″ b. to b.	
4×3 ×9/16	49.2	14.48	94.04	2.55	165.95	3.39	275.27	4.36
×½	44.4	13.00	85.81	2.57	150.82	3.41	249.49	4.38
×7/16	39.2	11.48	77.63	2.60	135.64	3.44	223.46	4.41
×⅜	34.0	9.92	68.20	2.62	118.68	3.46	194.96	4.43
×5/16	28.4	8.36	58.43	2.64	101.26	3.48	165.88	4.45
			5½″ b. to b.		8¼″ b. to b.		10¼″ b. to b.	
3×2½× ½	34.0	10.00	45.20	2.13	119.11	3.45	196.61	4.43
×7/16	30.4	8.88	40.95	2.15	107.07	3.47	176.25	4.45
× ⅜	26.4	7.68	36.12	2.17	93.73	3.49	153.86	4.48
×5/16	22.0	6.48	31.37	2.20	80.50	3.52	131.63	4.51
× ¼	18.0	5.24	25.85	2.22	65.87	3.55	107.43	4.53

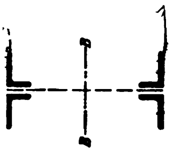


TABLE 9 (*Continued*)

FOUR ANGLES,

UNEQUAL LEGS, LONG

Size.	Total Section. Weight.	Total Section. Area.	Axis BB. 12¼″ b. to b. I	r	15¼″ b. to b. I	r	18¼″ b. to b. I	r	21¼″ b. to b. I	r
7×3½×¾	99.6	29.24	831.78	5.33	1358.54	6.82	2016.88	8.31	2806.80	9.80
×11/16	92.0	27.00	774.05	5.35	1262.08	6.84	1871.60	8.33	2602.63	9.82
×5/8	84.0	24.68	715.69	5.39	1164.00	6.87	1723.37	8.36	2393.81	9.85
×9/16	76.0	22.36	653.47	5.41	1060.98	6.89	1569.11	8.38	2177.86	9.87
×½	68.0	20.00	589.02	5.43	954.72	6.91	1410.42	8.40	1956.12	9.89
×7/16	60.0	17.60	524.28	5.46	847.68	6.94	1250.28	8.43	1732.08	9.92
			12¼″ b. to b.		15¼″ b. to b.		18¼″ b. to b.		21¼″ b. to b.	
6×4×¾	94.4	27.76	741.27	5.17	1223.88	6.64	1831.40	8.12	2563.85	9.61
×11/16	87.2	25.64	690.21	5.19	1137.50	6.66	1700.17	8.14	2378.22	9.63
×5/8	80.0	23.44	638.56	5.22	1049.58	6.69	1566.08	8.17	2188.06	9.66
×9/16	72.4	21.24	583.35	5.24	957.06	6.71	1426.36	8.19	1991.24	9.68
×½	64.8	19.00	526.08	5.26	861.52	6.73	1282.47	8.22	1788.91	9.70
×7/16	57.2	16.72	468.44	5.29	765.14	6.76	1137.08	8.25	1584.25	9.73
×3/8	49.2	14.44	407.81	5.31	664.91	6.79	987.00	8.27	1374.06	9.75
			12¼″ b. to b.		15¼″ b. to b.		18¼″ b. to b.		21¼″ b. to b.	
5×3½×5/8	67.2	19.68	546.36	5.27	896.17	6.75	1334.55	8.23	1861.48	9.73
×9/16	60.8	17.88	500.35	5.29	819.24	6.77	1218.59	8.26	1698.40	9.75
×½	54.4	16.00	451.34	5.31	737.66	6.79	1095.98	8.28	1526.30	9.77
×7/16	48.0	14.12	402.96	5.34	656.91	6.82	974.40	8.31	1355.43	9.80
×3/8	41.6	12.20	350.91	5.36	571.06	6.84	846.10	8.33	1176.05	9.82
×5/16	34.8	10.24	296.90	5.38	482.29	6.86	713.77	8.35	991.32	9.84
			12¼″ b. to b.		15¼″ b. to b.		18¼″ b. to b.		21¼″ b. to b.	
4×3×9/16	49.2	14.48	413.56	5.34	675.28	6.83	1002.17	8.32	1394.21	9.81
×½	44.4	13.00	374.16	5.36	609.92	6.85	904.17	8.34	1256.93	9.83
×7/16	39.2	11.48	334.24	5.40	543.47	6.88	804.35	8.37	1116.89	9.86
×3/8	34.0	9.92	291.08	5.42	472.47	6.90	698.50	8.39	969.17	9.88
×5/16	28.4	8.36	247.23	5.44	400.59	6.92	591.58	8.41	820.18	9.90
			12¼″ b. to b.		15¼″ b. to b.		18¼″ b. to b.			
3×2½×½	34.0	10.00	294.11	5.42	477.86	6.91	706.61	8.41		
×7/16	30.4	8.88	263.18	5.44	426.88	6.93	630.55	8.43		
×3/8	26.4	7.68	229.35	5.46	371.40	6.95	548.00	8.45		
×5/16	22.0	6.48	195.72	5.50	316.15	6.99	465.74	8.48		
×¼	18.0	5.24	159.46	5.52	257.16	7.01	378.44	8.50		

LACED

LEGS OUTSTANDING

Axis BB.							
24¼″ b. to b.		**28¼″ b. to b.**		**32¼″ b. to b.**		**36¼″ b. to b.**	
I	r	I	r	I	r	I	r
3728.30	11.29	5161.64	13.29	6828.91	15.28	8730.09	17.28
3455.15	11.31	4780.85	13.31	6322.55	15.30	8080.25	17.30
3175.30	11.34	4390.05	13.34	5802.24	15.33	7411.87	17.33
2887.24	11.36	3989.58	13.36	5270.81	15.35	6730.92	17.35
2591.82	11.38	3579.42	13.38	4727.02	15.37	6034.62	17.37
2293.08	11.41	3164.28	13.41	4176.28	15.40	5329.08	17.40
24¼″ b. to b.		**28¼″ b. to b.**		**32¼″ b. to b.**		**36¼″ b. to b.**	
3421.22	11.10	4758.70	13.09	6318.25	15.09	8099.89	17.08
3171.65	11.12	4409.04	13.11	5851.55	15.11	7499.17	17.10
2915.52	11.15	4049.55	13.14	5371.10	15.14	6880.16	17.13
2651.70	11.17	3680.99	13.16	4880.20	15.16	6249.33	17.15
2380.86	11.19	3303.12	13.18	4377.38	15.18	5603.64	17.17
2106.67	11.23	2920.26	13.22	3867.62	15.21	4948.73	17.20
1826.11	11.25	2529.91	13.24	3349.24	15.23	4284.08	17.22
24¼″ b. to b.		**28¼″ b. to b.**					
2476.97	11.22	3435.39	13.21				
2258.67	11.24	3130.85	13.23				
2028.62	11.26	2810.38	13.25				
1799.99	11.29	2491.59	13.28				
1560.90	11.31	2159.43	13.30				
1314.96	11.33	1818.15	13.32				
24¼″ b. to b.							
1851.42	11.31						
1668.18	11.33						
1481.09	11.36						
1284.47	11.38						
1086.40	11.40						

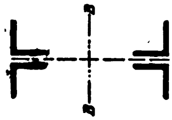


TABLE 10

FOUR ANGLES, EQUAL

Size.	Total Section. Weight.	Total Section. Area.	Axis BB. I	r	I	r	I	r	I	r
					16½" b. to b.		18¼" b. to b.		21¼" b. to b.	
8×8× 1	204.0	60.00	. . .	. .	2430.38	6.36	3093.72	7.18	4444.62	8.61
× 15/16	192.0	56.48	. . .	. .	2310.06	6.40	2937.45	7.21	4214.18	8.64
× 7/8	180.0	52.92	. . .	. .	2179.25	6.42	2768.94	7.23	3968.37	8.66
× 13/16	168.0	49.36	. . .	. .	2046.31	6.44	2598.06	7.25	3719.77	8.68
× 3/4	155.6	45.76	. . .	. .	1909.89	6.46	2423.00	7.28	3465.64	8.70
× 11/16	143.2	42.12	. . .	. .	1774.88	6.49	2249.39	7.31	3212.88	8.73
× 5/8	130.8	38.44	. . .	. .	1630.76	6.51	2065.16	7.33	2946.78	8.76
× 9/16	118.0	34.72	. . .	. .	1483.00	6.54	1876.57	7.35	2674.96	8.78
× 1/2	105.6	31.00	. . .	. .	1332.95	6.56	1685.44	7.37	2400.15	8.80
			12½" b. to b.		15¼" b. to b.		18¼" b. to b.		21¼" b. to b.	
6×6× 3/4	114.8	33.76	787.16	4.83	1265.98	6.12	1933.92	7.57	2753.78	9.03
× 11/16	106.0	31.12	734.94	4.86	1178.89	6.15	1797.40	7.60	2555.95	9.06
× 5/8	96.8	28.44	677.68	4.88	1084.96	6.18	1651.91	7.62	2346.84	9.08
× 9/16	87.6	25.72	618.41	4.90	988.15	6.20	1502.42	7.64	2132.43	9.11
× 1/2	78.4	23.00	559.99	4.93	892.53	6.23	1354.48	7.67	1919.94	9.14
× 7/16	68.8	20.24	497.14	4.96	790.88	6.25	1198.62	7.70	1697.43	9.16
× 3/8	59.2	17.44	432.20	4.98	686.26	6.27	1038.64	7.72	1469.50	9.18
					8½" b. to b.		10¼" b. to b.		12¼" b. to b.	
4×4× 5/8	62.8	18.44	. . .	. .	194.82	3.25	306.39	4.08	468.48	5.04
× 9/16	57.2	16.72	. . .	. .	179.00	3.27	280.75	4.10	428.39	5.06
× 1/2	51.2	15.00	. . .	. .	163.61	3.30	255.69	4.13	389.04	5.09
× 7/16	45.2	13.24	. . .	. .	146.30	3.32	228.03	4.15	346.26	5.11
× 3/8	39.2	11.44	. . .	. .	128.09	3.35	199.11	4.17	301.73	5.14
× 5/16	32.8	9.60	. . .	. .	108.89	3.37	168.82	4.19	255.32	5.16
			6½" b. to b.		8¼" b. to b.		10¼" b. to b.		12¼" b. to b.	
3×3× 1/2	37.6	11.00	68.09	2.49	121.17	3.32	202.46	4.29	305.75	5.27
× 7/16	33.2	9.72	61.18	2.51	108.43	3.34	180.65	4.31	272.31	5.29
× 3/8	28.8	8.44	54.05	2.53	95.37	3.36	158.41	4.33	238.34	5.31
× 5/16	24.4	7.12	46.37	2.55	81.48	3.38	134.95	4.35	202.66	5.33
× 1/4	19.6	5.76	38.41	2.58	67.12	3.41	110.72	4.38	165.84	5.37
			5½" b. to b.		8¼" b. to b.		10¼" b. to b.		12¼" b. to b.	
2½×2½× 7/16	27.2	8.00	35.49	2.11	93.95	3.43	155.47	4.41	232.99	5.40
× 3/8	23.6	6.92	31.32	2.13	82.28	3.45	135.77	4.43	203.10	5.42
× 5/16	20.0	5.88	27.16	2.15	70.77	3.47	116.46	4.45	173.91	5.44
× 1/4	16.4	4.76	22.42	2.17	57.99	3.49	95.16	4.47	141.86	5.46
× 3/16	12.4	3.60	17.48	2.20	44.68	3.52	73.01	4.50	108.54	5.49

LACED

LEGS

Axis BB.							
24¼″ b. to b.		28¼″ b. to b.		32¼″ b. to b.		36¼″ b. to b.	
I	r	I	r	I	r	I	r
6065.52	10.05	8646.72	12.00	11707.92	13.97	15249.12	15.94
5745.07	10.09	8181.61	12.04	11070.00	14.00	14410.23	15.97
5405.94	10.11	7693.15	12.06	10403.71	14.02	13537.63	15.99
5063.59	10.13	7200.88	12.08	9733.05	14.04	12660.10	16.02
4714.20	10.15	6699.27	12.10	9050.42	14.06	11767.65	16.04
4365.92	10.18	6198.14	12.13	8367.32	14.09	10873.46	16.07
4001.38	10.20	5676.60	12.15	7659.33	14.12	9949.59	16.09
3629.59	10.22	5145.46	12.17	6939.10	14.14	9010.49	16.11
3254.35	10.25	4610.29	12.20	6214.23	14.16	8066.17	16.13
24¼″ b. to b.		28¼″ b. to b.		32¼″ b. to b.		36¼″ b. to b.	
3725.56	10.50	5257.59	12.48	7059.70	14.46	9131.89	16.45
3454.54	10.54	4870.50	12.51	6535.42	14.49	8449.30	16.48
3169.75	10.56	4466.05	12.53	5989.86	14.51	7741.20	16.50
2878.19	10.58	4052.56	12.55	5432.70	14.53	7018.59	16.52
2588.89	10.61	3641.83	12.58	4878.77	14.56	6299.71	16.55
2287.33	10.63	3215.53	12.60	4305.66	14.59	5557.71	16.57
1978.83	10.65	2780.02	12.63	3720.74	14.61	4800.97	16.59
15¼″ b. to b.		18¼″ b. to b.		21¼″ b. to b.		24¼″ b. to b.	
780.76	6.51	1176.02	7.99	1654.27	9.47	2215.49	10.96
712.55	6.53	1071.94	8.01	1506.58	9.49	2016.45	10.98
645.31	6.56	969.09	8.04	1360.36	9.52	1819.14	11.01
573.26	6.58	859.84	8.06	1206.00	9.54	1611.74	11.03
498.55	6.60	746.86	8.08	1046.64	9.56	1397.91	11.05
421.06	6.62	630.01	8.10	882.15	9.59	1177.50	11.07
15¼″ b. to b.		18¼″ b. to b.					
501.93	6.75	747.62	8.24				
446.25	6.78	663.93	8.27				
389.88	6.80	579.40	8.29				
330.93	6.82	491.23	8.31				
270.13	6.85	400.33	8.34				

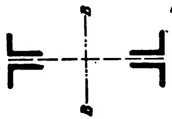


TABLE 11

FOUR ANGLES, LACED

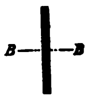
UNEQUAL LEGS, SHORT LEGS OUTSTANDING

Size.	Total Section. Wgt.	Total Section. Area.	Axis BB. I	r	I	r	I	r	I	r	I	r	I	r	I	r	I	r
					14½″ b. to b.		18¼″ b. to b.		21¼″ b. to b.		24¼″ b. to b.		28¼″ b. to b.		32¼″ b. to b.		36¼″ b. to b.	
7×3½×¾	99.6	29.24	. . .	. .	770.77	5.13	1381.25	6.87	2017.66	8.31	2785.65	9.76	4014.31	11.72	5476.90	13.69	7173.40	15.66
×11/16	92.0	27.00	. . .	. .	717.69	5.16	1283.42	6.89	1872.70	8.33	2583.47	9.78	3720.17	11.74	5072.87	13.71	6641.57	15.68
×⅝	84.0	24.68	. . .	. .	663.99	5.19	1183.89	6.93	1724.75	8.36	2376.68	9.81	3418.66	11.77	4658.09	13.74	6094.96	15.71
×9/16	76.0	22.36	. . .	. .	606.65	5.21	1079.36	6.95	1570.72	8.38	2162.70	9.84	3108.53	11.79	4233.23	13.76	5536.82	15.74
×½	68.0	20.00	. . .	. .	547.21	5.23	971.52	6.97	1412.22	8.40	1942.92	9.86	2790.52	11.81	3798.12	13.78	4965.72	15.76
×7/16	60.0	17.60	. . .	. .	487.34	5.26	862.72	7.00	1252.12	8.43	1720.72	9.89	2468.72	11.84	3357.52	13.81	4387.12	15.79
			12½″ b to b.		15¼″ b. to b.		18¼″ b. to b.		21¼″ b. to b.		24¼″ b. to b.		28¼″ b. to b.		32¼″ b. to b.		36¼″ b. to b.	
6×4×¾	94.4	27.76	580.76	4.57	951.58	5.85	1475.83	7.29	2124.99	8.75	2899.08	10.22	4125.52	12.19	5574.03	14.17	7244.63	16.16
×11/16	87.2	25.64	541.42	4.60	885.33	5.88	1371.08	7.31	1972.21	8.77	2688.72	10.24	3823.55	12.21	5163.49	14.19	6708.56	16.18
×⅝	80.0	23.44	501.71	4.63	818.05	5.91	1264.23	7.34	1815.89	8.80	2473.03	10.27	3513.29	12.24	4741.08	14.22	6156.39	16.21
×9/16	72.4	21.24	458.88	4.65	746.70	5.93	1152.28	7.37	1653.44	8.82	2250.17	10.29	3194.50	12.26	4308.75	14.24	5592.92	16.23
×½	64.8	19.00	414.40	4.67	672.91	5.95	1036.86	7.39	1486.30	8.84	2021.25	10.31	2867.51	12.29	3865.77	14.26	5016.03	16.25
×7/16	57.2	16.72	369.56	4.70	598.42	5.98	920.20	7.42	1317.21	8.88	1789.47	10.35	2536.19	12.32	3416.66	14.29	4430.90	16.28
×⅜	49.2	14.44	322.12	4.72	520.57	6.00	799.33	7.44	1143.08	8.90	1551.80	10.37	2197.85	12.34	2959.41	14.32	3836.50	16.30
			10½″ b. to b.		12¼″ b. to b.		15¼″ b. to b.		18¼″ b. to b.		21¼″ b. to b.		24¼″ b. to b.		28¼″ b. to b.		32¼″ b. to b.	
5×3½×⅝	67.2	19.68	296.14	3.88	433.47	4.69	739.00	6.13	1133.09	7.59	1615.74	9.06	2186.95	10.54	3086.33	12.52	4143.15	14.51
×9/16	60.8	17.88	272.00	3.90	397.39	4.71	676.05	6.15	1035.17	7.61	1474.75	9.08	1994.79	10.56	2813.34	12.54	3774.93	14.53
×½	54.4	16.00	246.17	3.92	358.94	4.74	609.26	6.17	931.58	7.63	1325.90	9.10	1792.22	10.58	2525.98	12.56	3387.74	14.55
×7/16	48.0	14.12	220.63	3.95	320.89	4.77	543.07	6.20	828.79	7.66	1178.05	9.13	1590.85	10.61	2240.09	12.60	3002.28	14.58
×⅜	41.6	12.20	192.77	3.97	279.82	4.79	472.52	6.22	720.12	7.68	1022.62	9.16	1380.02	10.64	1941.95	12.62	2601.48	14.60
×5/16	34.8	10.24	163.57	4.00	237.00	4.81	399.35	6.24	607.79	7.70	862.30	9.18	1162.90	10.66	1635.37	12.64	2189.77	14.62

MOMENT OF INERTIA OF ONE PLATE ABOUT AXIS AA

Depth of Plate in Inches.	Thickness of Plate in Inches.												
	$\frac{1}{4}$	$\frac{5}{16}$	$\frac{3}{8}$	$\frac{7}{16}$	$\frac{1}{2}$	$\frac{9}{16}$	$\frac{5}{8}$	$\frac{11}{16}$	$\frac{3}{4}$	$\frac{13}{16}$	$\frac{7}{8}$	$\frac{15}{16}$	1
4	.01	.01	.02	.03	.04	.06	.08	.11	.14	.18	.22	.27	.33
5	.01	.01	.02	.03	.05	.07	.10	.14	.18	.22	.28	.34	.42
6	.01	.02	.03	.04	.06	.09	.12	.16	.21	.27	.33	.41	.50
7	.01	.02	.03	.05	.07	.10	.14	.19	.25	.31	.39	.48	.58
8	.01	.02	.04	.06	.08	.12	.16	.22	.28	.36	.45	.55	.67
9	.01	.02	.04	.06	.09	.13	.18	.24	.32	.40	.50	.62	.75
10	.01	.03	.04	.07	.10	.15	.20	.27	.35	.45	.56	.69	.83
11	.01	.03	.05	.08	.11	.16	.22	.30	.39	.49	.61	.76	.92
12	.02	.03	.05	.08	.13	.18	.24	.32	.42	.54	.67	.82	1.00
13	.02	.03	.06	.09	.14	.19	.26	.35	.46	.58	.73	.89	1.08
14	.02	.04	.06	.10	.15	.21	.28	.38	.49	.63	.78	.96	1.17
15	.02	.04	.07	.10	.16	.22	.31	.41	.53	.67	.84	1.03	1.25
16	.02	.04	.07	.11	.17	.24	.33	.43	.56	.72	.89	1.10	1.33
17	.02	.04	.07	.12	.18	.25	.35	.46	.60	.76	.95	1.17	1.42
18	.02	.05	.08	.13	.19	.27	.37	.49	.63	.80	1.00	1.24	1.50
19	.02	.05	.08	.13	.20	.28	.39	.51	.67	.85	1.06	1.30	1.58
20	.03	.05	.09	.14	.21	.30	.41	.54	.70	.89	1.12	1.37	1.67
21	.03	.05	.09	.15	.22	.31	.43	.57	.74	.94	1.17	1.44	1.75
22	.03	.06	.10	.15	.23	.33	.45	.60	.77	.98	1.23	1.51	1.83
23	.03	.06	.10	.16	.24	.34	.47	.62	.81	1.03	1.28	1.58	1.92
24	.03	.06	.11	.17	.25	.36	.49	.65	.84	1.07	1.34	1.65	2.00
25	.03	.06	.11	.17	.26	.37	.51	.68	.88	1.12	1.40	1.72	2.08
26	.03	.07	.11	.18	.27	.39	.53	.70	.91	1.16	1.45	1.79	2.17
27	.04	.07	.12	.19	.28	.40	.55	.73	.95	1.21	1.51	1.85	2.25
28	.04	.07	.12	.20	.29	.42	.57	.76	.98	1.25	1.56	1.92	2.33
29	.04	.07	.13	.20	.30	.43	.59	.79	1.02	1.30	1.62	1.99	2.42
30	.04	.08	.13	.21	.31	.44	.61	.81	1.05	1.34	1.67	2.06	2.50
32	.04	.08	.14	.22	.33	.47	.65	.87	1.12	1.43	1.79	2.20	2.67
34	.04	.09	.15	.24	.35	.50	.69	.92	1.20	1.52	1.90	2.33	2.83
36	.05	.09	.16	.25	.38	.53	.73	.97	1.27	1.61	2.01	2.47	3.00
38	.05	.10	.17	.27	.40	.56	.77	1.03	1.34	1.70	2.12	2.61	3.17
40	.05	.10	.18	.28	.42	.59	.81	1.08	1.41	1.79	2.23	2.75	3.33
42	.05	.11	.18	.29	.44	.62	.85	1.14	1.48	1.88	2.34	2.88	3.50
44	.06	.11	.19	.31	.46	.65	.90	1.19	1.55	1.97	2.46	3.02	3.67
46	.06	.12	.20	.32	.48	.68	.94	1.25	1.62	2.06	2.57	3.16	3.83
48	.06	.12	.21	.33	.50	.71	.98	1.30	1.69	2.15	2.68	3.30	4.00
50	.07	.13	.22	.35	.52	.74	1.02	1.35	1.76	2.23	2.79	3.43	4.17
54	.07	.14	.24	.38	.56	.80	1.10	1.46	1.90	2.41	3.01	3.71	4.50
60	.08	.15	.26	.42	.63	.89	1.22	1.62	2.11	2.68	3.35	4.12	5.00

TABLE 13



MOMENT OF INERTIA OF

Width of Plate in Inches	Thickness of Plate in Inches						
	1/4	5/16	3/8	7/16	1/2	9/16	5/8
4	1.33	1.67	2.00	2.33	2.67	3.00	3.33
5	2.60	3.26	3.91	4.56	5.21	5.86	6.51
6	4.50	5.63	6.75	7.88	9.00	10.13	11.25
7	7.15	8.93	10.72	12.51	14.29	16.08	17.86
8	10.67	13.33	16.00	18.67	21.33	24.00	26.67
9	15.19	18.98	22.78	26.58	30.38	34.17	37.97
10	20.83	26.04	31.25	36.46	41.67	46.88	52.08
11	27.73	34.66	41.59	48.53	55.46	62.39	69.32
12	36.00	45.00	54.00	63.00	72.00	81.00	90.00
13	45.77	57.21	68.66	80.10	91.54	102.98	114.43
14	57.17	71.46	85.75	100.04	114.33	128.63	142.92
15	70.31	87.89	105.47	123.05	140.63	158.20	175.78
16	85.33	106.67	128.00	149.33	170.67	192.00	213.33
17	102.35	127.94	153.53	179.12	204.71	230.30	255.89
18	121.50	151.88	182.25	212.63	243.00	273.38	303.75
19	142.90	178.62	214.34	250.07	285.79	321.52	357.24
20	166.67	208.33	250.00	291.67	333.33	375.00	416.67
21	192.94	241.17	289.41	337.64	385.88	434.11	482.34
22	221.83	277.29	332.75	388.21	443.67	499.13	554.58
23	253.48	316.85	380.22	443.59	506.96	570.33	633.70
24	288.00	360.00	432.00	504.00	576.00	648.00	720.00
25	325.52	406.90	488.28	569.66	651.04	732.42	813.80
26	366.17	457.71	549.25	640.79	732.33	823.88	915.42
27	410.06	512.58	615.09	717.61	820.13	922.64	1025.16
28	457.33	571.67	686.00	800.33	914.67	1029.00	1143.33
29	508.10	635.13	762.16	889.18	1016.21	1143.23	1270.26
30	562.50	703.13	843.75	984.38	1125.00	1265.63	1406.25
32	682.67	853.33	1024.00	1194.67	1365.33	1536.00	1706.67
34	818.83	1023.54	1228.25	1432.96	1637.67	1842.38	2047.08
36	972.00	1215.00	1458.00	1701.00	1944.00	2187.00	2430.00
38	1143.17	1428.96	1714.75	2000.54	2286.33	2572.13	2857.92
40	1333.33	1666.67	2000.00	2333.33	2666.67	3000.00	3333.33
42	1543.50	1929.38	2315.25	2701.13	3087.00	3472.88	3858.75
44	1774.67	2218.33	2662.00	3105.67	3549.33	3993.00	4436.67
46	2027.83	2534.79	3041.75	3548.71	4055.67	4562.63	5069.58
48	2304.00	2880.00	3456.00	4032.00	4608.00	5184.00	5760.00
50	2604.17	3255.21	3906.25	4557.29	5208.33	5859.38	6510.42
54	3280.50	4100.63	4920.75	5740.88	6561.00	7381.13	8201.25
60	4500.00	5625.00	6750.00	7875.00	9000.00	10125.00	11250.00

ONE PLATE ABOUT AXIS BB

Thickness of Plate in Inches.						
$\frac{11}{16}$	$\frac{3}{4}$	$\frac{13}{16}$	$\frac{7}{8}$	$\frac{15}{16}$	1	$\frac{1}{16}$
3.67	4.00	4.33	4.67	5.00	5.33	.33
7.16	7.81	8.46	9.11	9.77	10.42	.65
12.38	13.50	14.63	15.75	16.88	18.00	1.13
19.65	21.44	23.22	25.01	26.80	28.58	1.79
29.33	32.00	34.67	37.33	40.00	42.67	2.67
41.77	45.56	49.36	53.16	56.95	60.75	3.80
57.29	62.50	67.71	72.92	78.13	83.33	5.21
76.26	83.19	90.12	97.05	103.98	110.92	6.93
99.00	108.00	117.00	126.00	135.00	144.00	9.00
125.87	137.31	148.76	160.20	171.64	183.08	11.44
157.21	171.50	185.79	200.08	214.38	228.67	14.29
193.36	210.94	228.52	246.09	263.67	281.25	17.58
234.67	256.00	277.33	298.67	320.00	341.33	21.33
281.47	307.06	332.65	358.24	383.83	409.42	25.59
334.13	364.50	394.88	425.25	455.63	486.00	30.38
392.96	428.69	464.41	500.14	535.86	571.58	35.72
458.33	500.00	541.67	583.33	625.00	666.67	41.67
530.58	578.81	627.05	675.28	723.52	771.75	48.23
610.04	665.50	720.96	776.42	831.88	887.33	55.46
697.07	760.44	823.81	887.18	950.55	1013.92	63.37
792.00	864.00	936.00	1008.00	1080.00	1152.00	72.00
895.18	976.56	1057.94	1139.32	1220.70	1302.08	81.38
1006.96	1098.50	1190.04	1281.58	1373.13	1464.67	91.54
1127.67	1230.19	1332.70	1435.22	1537.73	1640.25	102.52
1257.67	1372.00	1486.33	1600.67	1715.00	1829.33	114.33
1397.29	1524.31	1651.34	1778.36	1905.39	2032.42	127.03
1546.88	1687.50	1828.13	1968.75	2109.38	2250.00	140.63
1877.33	2048.00	2218.67	2389.33	2560.00	2730.67	170.67
2251.79	2456.50	2661.21	2865.92	3070.63	3275.33	204.71
2673.00	2916.00	3159.00	3402.00	3645.00	3888.00	243.00
3143.71	3429.50	3715.29	4001.08	4286.88	4572.67	285.79
3666.67	4000.00	4333.33	4666.67	5000.00	5333.33	333.33
4244.63	4630.50	5016.38	5402.25	5788.13	6174.00	385.88
4880.33	5324.00	5767.67	6211.33	6655.00	7098.67	443.67
5576.54	6083.50	6590.46	7097.42	7604.38	8111.33	506.96
6336.00	6912.00	7488.00	8064.00	8640.00	9216.00	576.00
7161.46	7812.50	8463.54	9114.58	9765.63	10416.67	651.04
9021.38	9841.50	10661.63	11481.75	12301.88	13122.00	820.13
12375.00	13500.00	14625.00	15750.00	16875.00	18000.00	1125.00

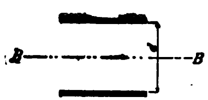


TABLE 14

MOMENT OF INERTIA OF TWO COVER PLATES FOR ANGLE COLUMNS

ABOUT AXIS BB

Width of Plates.	d	Thickness of Plates in Inches.												
		1/4	5/16	3/8	7/16	1/2	9/16	5/8	11/16	3/4	13/16	7/8	15/16	1
Area of Plates.			11.25	13.50	15.75	18.00	20.25	22.50	24.75	27.00	29.25	31.50	33.75	36.00
18	36¼	. . . .	3759.89	4527.35	5300.02	6077.91	6861.03	7649.41	8443.07	9242.01	10046.27	10855.85	11670.77	12491.06
"	32¼	. . . .	2982.23	3592.48	4207.36	4826.91	5451.12	6080.04	6713.66	7352.01	7995.11	8642.97	9295.62	9953.06
"	28¼	. . . .	2294.57	2765.60	3240.70	3719.91	4203.22	4690.66	5182.26	5678.01	6177.96	6682.10	7190.46	7703.06
"	24¼	. . . .	1696.92	2046.73	2400.05	2756.91	3117.31	3481.29	3848.85	4220.01	4594.80	4973.22	5355.31	5741.06
"	21¼	. . . .	1307.74	1578.45	1852.24	2129.16	2409.19	2692.38	2978.73	3268.26	3561.00	3856.94	4156.13	4458.56
"	18¼	. . . .	969.18	1170.91	1375.31	1582.41	1792.20	2004.73	2219.99	2438.01	2658.82	2882.41	3108.82	3338.06
"	15¼	. . . .	681.25	824.13	969.26	1116.66	1266.33	1418.32	1572.62	1729.26	1888.26	2049.63	2213.39	2379.56
Area of Plates.			10.00	12.00	14.00	16.00	18.00	20.00	22.00	24.00	26.00	28.00	30.00	32.00
16	36¼	. . . .	3342.12	4024.31	4711.13	5402.58	6098.69	6799.48	7504.95	8215.12	8930.02	9649.65	10374.02	11103.17
"	32¼	. . . .	2650.87	3193.31	3739.88	4290.58	4845.44	5404.48	5967.70	6535.12	7106.77	7682.65	8262.77	8847.17
"	28¼	. . . .	2039.62	2458.31	2880.63	3306.58	3736.19	4169.48	4606.45	5047.12	5491.52	5939.65	6391.52	6847.17
"	24¼	. . . .	1508.37	1819.31	2133.38	2450.58	2770.94	3094.48	3421.20	3751.12	4084.27	4420.65	4760.27	5103.17
"	21¼	. . . .	1162.43	1403.06	1646.44	1892.58	2141.51	2393.23	2647.76	2905.12	3165.33	3428.40	3694.33	3963.17
"	18¼	. . . .	861.50	1040.81	1222.50	1406.58	1593.07	1781.98	1973.32	2167.12	2363.39	2562.15	2763.40	2967.17
"	15¼	. . . .	605.56	732.56	861.56	992.58	1125.63	1260.73	1397.89	1537.12	1678.46	1821.90	1967.46	2115.17
Area of Plates.			8.75	10.50	12.25	14.00	15.75	17.50	19.25	21.00	22.75	24.50	26.25	28.00
14	36¼	. . . .	2924.36	3521.27	4122.24	4727.26	5336.36	5949.54	6566.83	7188.23	7813.76	8443.44	9077.27	9715.27
"	32¼	. . . .	2319.51	2794.15	3272.39	3754.26	4239.76	4728.92	5221.74	5718.23	6218.42	6722.31	7229.93	7741.27
"	28¼	. . . .	1784.67	2151.02	2520.55	2893.26	3269.17	3648.29	4030.64	4416.23	4805.08	5197.19	5592.58	5991.27
"	24¼	. . . .	1319.82	1591.90	1866.70	2144.26	2424.58	2707.67	2993.55	3282.23	3573.73	3868.06	4165.24	4465.27
"	21¼	. . . .	1017.13	1227.68	1440.63	1656.01	1873.82	2094.07	2316.79	2541.98	2769.66	2999.85	3232.54	3467.77
"	18¼	. . . .	753.81	910.71	1069.69	1230.76	1393.94	1559.23	1726.66	1896.23	2067.97	2241.88	2417.97	2596.27
"	15¼	. . . .	529.86	640.99	753.87	868.51	984.93	1103.14	1223.15	1344.98	1468.65	1594.16	1721.53	1850.77

TABLE 14 (*Continued*)

Width of Plates.	d	Thickness of Plates in Inches.												
		1/4	5/16	3/8	7/16	1/2	9/16	5/8	11/16	3/4	13/16	7/8	15/16	1
A. of Pls.		6.00	7.50	9.00	10.50	12.00	13.50	15.00	16.50	18.00	19.50	21.00	22.50	24.00
12	36¼	1998.41	2506.59	3018.23	3533.34	4051.94	4574.02	5099.61	5628.71	6161.34	6697.51	7237.23	7780.52	8327.38
"	32¼	1584.41	1988.15	2394.98	2804.91	3217.94	3634.08	4053.36	4475.77	4901.34	5330.08	5761.98	6197.08	6635.38
"	28¼	1218.41	1529.72	1843.73	2160.47	2479.94	2802.14	3127.11	3454.84	3785.34	4118.64	4454.73	4793.64	5135.38
"	24¼	900.41	1131.28	1364.48	1600.03	1837.94	2078.21	2320.86	2565.90	2813.34	3063.20	3315.48	3570.20	3827.38
"	21¼	693.41	871.83	1052.30	1234.83	1419.44	1606.13	1794.92	1985.82	2178.84	2374.00	2571.30	2770.75	2972.38
"	18¼	513.41	646.12	780.61	916.88	1054.94	1194.80	1336.48	1479.99	1625.34	1772.54	1921.61	2072.55	2225.38
"	15¼	360.41	454.17	549.42	646.17	744.44	844.22	945.55	1048.41	1152.84	1258.84	1366.42	1475.59	1586.38
"	12¼	234.41	295.97	358.73	422.72	487.94	554.39	622.11	691.09	761.34	832.89	905.73	979.89	1055.38
A. of Pls.		5.00	6.25	7.50	8.75	10.00	11.25	12.50	13.75	15.00	16.25	17.50	18.75	20.00
10	36¼	1665.34	2088.83	2515.19	2944.45	3376.61	3811.68	4249.67	4690.59	5134.45	5581.26	6031.03	6483.76	6939.48
"	32¼	1320.34	1656.79	1995.82	2337.42	2681.61	3028.40	3377.80	3729.81	4084.45	4441.73	4801.65	5164.23	5529.48
"	28¼	1015.34	1274.76	1536.44	1800.39	2066.61	2335.12	2605.92	2879.03	3154.45	3432.20	3712.28	3994.70	4279.48
"	24¼	750.34	942.73	1137.07	1333.36	1531.61	1731.84	1934.05	2138.25	2344.45	2552.67	2762.90	2975.17	3189.48
"	21¼	577.84	726.52	876.91	1029.02	1182.86	1338.44	1495.77	1654.85	1815.70	1978.33	2142.75	2308.96	2476.98
"	18¼	427.84	538.44	650.51	764.06	879.11	995.67	1113.74	1233.33	1354.45	1477.12	1601.34	1727.12	1854.48
"	15¼	300.34	378.47	457.85	538.48	620.36	703.52	787.95	873.68	960.70	1049.03	1138.68	1229.66	1321.98
"	12¼	195.34	246.64	298.94	352.27	406.61	462.00	518.42	575.90	634.45	694.07	754.78	816.58	879.48
A. of Pls.		4.50	5.63	6.75	7.88	9.00	10.13	11.25	12.38	13.50	14.63	15.75	16.88	18.00
9	36¼	1498.80	1879.94	2263.67	2650.01	3038.95	3430.52	3824.71	4221.53	4621.01	5023.13	5427.92	5835.39	6245.53
"	32¼	1188.30	1491.11	1796.24	2103.68	2413.45	2725.56	3040.02	3356.83	3676.01	3997.56	4321.49	4647.81	4976.53
"	28¼	913.80	1147.29	1382.80	1620.35	1859.95	2101.61	2345.33	2591.13	2839.01	3088.98	3341.05	3595.23	3851.53
"	24¼	675.30	848.46	1023.36	1200.02	1378.45	1558.66	1740.64	1924.42	2110.01	2297.40	2486.61	2677.65	2870.53
"	21¼	520.05	653.87	789.22	926.12	1064.58	1204.60	1346.19	1489.37	1634.13	1780.50	1928.47	2078.06	2229.28
"	18¼	385.05	484.59	585.46	687.66	791.20	896.10	1002.36	1109.99	1219.01	1329.41	1441.21	1554.41	1669.03
"	15¼	270.30	340.63	412.07	484.63	558.33	633.17	709.16	786.31	864.63	944.13	1024.82	1106.69	1189.78
"	12¼	175.80	221.97	269.05	317.04	365.95	415.80	466.58	518.31	571.01	624.67	679.30	734.92	791.53

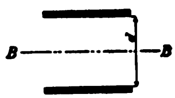


TABLE 15

MOMENT OF INERTIA OF TWO COVER PLATES FOR Z-BAR COLUMNS

ABOUT AXIS BB

Thickness of plate equals thickness of Z-bar

Depth of Z-bar.	Thickness of Metal for Z-bar and Web Plate.	Width of Cover Plate.	*d.*	Thickness of Cover Plates in Inches.					
				$\frac{3}{8}$	$\frac{1}{2}$	$\frac{5}{8}$	$\frac{3}{4}$	$\frac{7}{8}$	1
6	$\frac{3}{4}$	17	$12\frac{3}{4}$	. . . .	746.14	950.36	1161.84	1380.70	1607.03
6	$\frac{5}{8}$	16	"	. . . .	702.25	894.45	1093.50	1299.48	1512.50
6	$\frac{1}{2}$	15	"	. . . .	658.36	838.55	1025.16	1218.27	1417.97
		14	"	. . . .	614.47	782.65	956.81	1137.05	1323.44
5	$\frac{5}{8}$	14	$10\frac{7}{8}$	332.23	452.87	578.59	709.49	845.63	987.11
5	$\frac{5}{8}$	13	"	308.50	420.52	537.27	658.81	785.23	916.60
5	$\frac{1}{2}$	14	$10\frac{1}{2}$	310.45	423.50	541.47	664.45	792.52	925.75
5	$\frac{1}{2}$	13	"	288.27	393.25	502.80	616.99	735.91	859.63

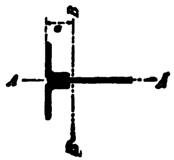


TABLE 16

TWO ANGLES AND ONE PLATE

Thickness of plate equals thickness of angles. Plate dropped ⅛″ below back of angles

Size of Angles.	Area of Angles.	Total Area.	Axis BB. I	Axis BB. r	Axis BB. e	Axis AA. I	Axis AA. r	Total Area.	Axis BB. I	Axis BB. r	Axis BB. e	Axis AA. I	Axis AA. r	Total Area.	Axis BB. I	Axis BB. r	Axis BB. e	Axis AA. I	Axis AA. r
		12″ pl.						15″ pl.						18″ pl.					
6×6× 5/8	14.22	21.72	233.17	3.28	3.25	107.89	2.23	23.60	420.45	4.22	4.07	107.95	2.14	25.47	695.55	5.23	5.00	108.01	2.06
× 1/2	11.50	17.50	189.72	3.29	3.20	82.78	2.17	19.00	340.88	4.24	4.03	82.82	2.09	20.50	562.66	5.24	4.95	82.84	2.01
× 7/16	10.12	15.37	167.27	3.30	3.19	71.16	2.15	16.68	300.05	4.24	4.01	71.18	2.07	18.00	494.78	5.24	4.93	71.20	1.99
		12″ pl.						15″ pl.						18″ pl.					
6×4× 5/8	11.72	19.22	223.76	3.41	3.02	106.70	2.36	21.10	417.36	4.45	3.96	106.76	2.25	22.97	694.93	5.50	4.99	106.82	2.16
× 1/2	9.50	15.50	181.51	3.42	2.98	82.59	2.31	17.00	337.67	4.46	3.92	82.62	2.20	18.50	561.39	5.51	4.95	82.65	2.11
× 7/16	8.36	13.61	160.23	3.43	2.95	70.69	2.28	14.92	297.56	4.47	3.89	70.71	2.18	16.24	494.17	5.52	4.92	70.73	2.09
× 3/8	7.22	11.72	138.33	3.44	2.93	59.67	2.26	12.85	256.56	4.47	3.87	59.68	2.16	13.97	425.76	5.52	4.89	59.70	2.07
		10″ pl.						12″ pl.						15″ pl.					
5×3½ × 1/2	8.00	13.00	104.43	2.83	2.53	49.27	1.95	14.00	173.34	3.52	3.15	49.29	1.88	15.50	323.27	4.57	4.16	49.32	1.78
× 7/16	7.06	11.44	92.39	2.84	2.50	42.00	1.92	12.31	153.09	3.53	3.12	42.01	1.85	13.62	285.04	4.57	4.13	42.03	1.76
× 3/8	6.10	9.85	79.85	2.85	2.48	35.31	1.89	10.60	132.14	3.53	3.10	35.32	1.83	11.73	245.76	4.58	4.11	35.33	1.74
× 5/16	5.12	8.25	67.11	2.85	2.46	28.84	1.87	8.87	110.90	3.54	3.07	28.84	1.80	9.81	205.99	4.58	4.08	28.85	1.72
		9″ pl.						12″ pl.						15″ pl.					
4×3× 1/2	6.50	11.00	73.51	2.59	2.38	26.42	1.55	12.50	164.32	3.63	3.37	26.45	1.45	14.00	306.25	4.68	4.47	26.48	1.38
× 7/16	5.74	9.68	65.11	2.59	2.36	22.34	1.52	10.99	145.11	3.63	3.34	22.36	1.43	12.30	270.03	4.68	4.44	22.38	1.35
× 3/8	4.96	8.34	56.31	2.60	2.34	18.64	1.50	9.46	125.25	3.64	3.32	18.65	1.40	10.59	232.81	4.69	4.42	18.67	1.33
× 5/16	4.18	6.99	47.40	2.60	2.31	15.17	1.47	7.93	105.20	3.64	3.30	15.17	1.38	8.87	195.33	4.69	4.39	15.18	1.31
		8″ pl.						10″ pl.						12″ pl.					
3×2½× 7/16	4.44	7.94	43.59	2.34	2.23	10.19	1.13	8.82	81.38	3.04	2.91	10.21	1.08	9.69	135.38	3.74	3.65	10.22	1.03
× 3/8	3.84	6.84	37.72	2.35	2.21	8.41	1.11	7.59	70.31	3.04	2.89	8.42	1.05	8.34	116.83	3.74	3.63	8.43	1.01
× 5/16	3.24	5.74	31.88	2.36	2.18	6.68	1.08	6.37	59.27	3.05	2.86	6.69	1.03	6.99	98.33	3.75	3.60	6.69	.98
× 1/4	2.62	4.62	25.76	2.36	2.16	5.16	1 06	5.12	47.82	3.06	2.84	5.16	1.00	5.62	79.25	3.76	3.58	5.16	.96

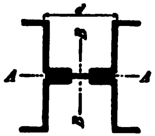


TABLE 17

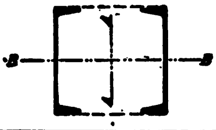
FOUR Z-BARS AND ONE PLATE

d = WIDTH OF PLATE + ½ INCH

THICKNESS OF PLATE EQUALS THICKNESS OF Z-BAR.

Depth of Z-bar	Width of Plate	Area.	Axis BB. I	Axis BB. r	Axis AA. I	Axis AA. r	Area.	Axis BB. I	Axis BB. r	Axis AA. I	Axis AA. r	Area.	Axis BB. I	Axis BB. r	Axis AA. I	Axis AA. r	Area.	Axis BB. I	Axis BB. r	Axis AA. I	Axis AA. r
		⅜″ Metal.					7/16″ Metal.					½″ Metal.					9/16″ Metal.				
6	10	22.11	515.29	4.83	287.86	3.61	25.94	599.23	4.81	347.00	3.66	29.76	681.58	4.79	409.23	3.71	32.35	724.14	4.73	426.39	3.63
6	8	21.36	337.09	3.97	287.86	3.67	25.06	391.45	3.95	346.98	3.72	28.76	444.60	3.93	409.21	3.77	31.22	469.13	3.88	426.36	3.70
		⅝″ Metal.					11/16″ Metal.					¾″ Metal.									
6	10	36.09	800.86	4.71	489.27	3.68	39.88	877.04	4.69	555.87	3.73	42.02	903.12	4.64	562.04	3.66					
6	8	34.84	518.08	3.86	489.23	3.75	38.50	566.52	3.84	555.82	3.80	40.52	579.20	3.78	561.97	3.72					
		5/16″ Metal.					⅜″ Metal.					7/16″ Metal.					½″ Metal.				
5	8	16.10	252.27	3.96	149.42	3.05	19.40	300.86	3.94	185.98	3.10	22.74	349.05	3.92	225.16	3.15	25.00	372.86	3.86	235.66	3.07
5	7	15.79	197.29	3.54	149.41	3.08	19.03	235.11	3.52	185.97	3.13	22.30	272.54	3.50	225.16	3.18	24.50	289.69	3.44	235.64	3.10
		9/16″ Metal.					⅝″ Metal.														
5	8	28.26	417.08	3.84	275.38	3.12	31.56	460.96	3.82	317.82	3.17										
5	7	27.70	323.77	3.42	275.37	3.15	30.94	357.54	3.40	317.80	3.21										
		¼″ Metal.					5/16″ Metal.					⅜″ Metal.					7/16″ Metal.				
4	8	11.64	181.83	3.95	68.66	2.43	14.62	226.07	3.93	89.78	2.48	17.64	270.06	3.91	112.67	2.53	19.70	292.78	3.86	118.45	2.45
4	7	11.39	142.16	3.53	68.66	2.46	14.31	176.60	3.51	89.77	2.51	17.27	210.79	3.49	112.67	2.55	19.26	227.39	3.44	118.44	2.48
3	7	9.63	114.92	3.45	32.30	1.83	12.11	142.85	3.43	42.83	1.88	14.07	161.58	3.39	48.01	1.85	16.50	187.44	3.37	59.49	1.90
3	6	9.38	86.66	3.04	32.30	1.86	11.80	107.61	3.02	42.82	1.91	13.69	121.14	2.97	48.00	1.87	16.07	140.39	2.96	59.48	1.92
		½″ Metal.					9/16″ Metal.														
4	8	22.64	333.06	3.84	141.81	2.50	25.58	372.48	3.82	166.87	2.55										
4	7	22.14	258.45	3.42	141.80	2.53	25.02	288.81	3.40	166.86	2.58										
3	7	18.26	201.82	3.32	63.63	1.87															
3	6	17.76	150.40	2.91	63.62	1.89															

TABLE 18



TWO CHANNELS LACED, FLANGES IN

Size of Channel.		Total Section.		Axis BB.		Axis AA.					
						10″ b. to b.		11″ b. to b.		12″ b. to b.	
Depth.	Weight.	Weight.	Area.	I	r	I	r	I	r	I	r
15	55	110	32.36	860.4	5.16	588.98	4.27	732.23	4.76	891.67	5.25
"	50	100	29.42	805.4	5.23	540.67	4.29	671.50	4.78	817.04	5.27
"	45	90	26.48	750.2	5.32	490.36	4.30	608.51	4.79	739.91	5.29
"	40	80	23.52	695.0	5.43	437.04	4.31	542.10	4.80	658.93	5.29
"	35	70	20.58	640.0	5.58	381.90	4.31	473.70	4.80	575.80	5.29
"	33	66	19.80	625.2	5.62	366.73	4.30	454.96	4.79	553.09	5.29
						9″ b. to b.		10″ b. to b.		11″ b. to b.	
12	40	80	23.52	394.0	4.09	348.97	3.85	443.71	4.34	550.20	4.84
"	35	70	20.58	358.6	4.17	309.91	3.88	393.39	4.37	487.15	4.87
"	30	60	17.64	323.4	4.28	268.23	3.90	340.08	4.39	420.75	4.88
"	25	50	14.70	288.0	4.43	223.79	3.90	283.65	4.39	350.86	4.89
"	20.5	41	12.06	256.2	4.61	181.60	3.88	230.39	4.37	285.22	4.86
						9″ b. to b.		10″ b. to b.		11″ b. to b.	
10	25	50	14.70	182.0	3.52	228.10	3.94	288.81	4.43	356.87	4.93
"	20	40	11.76	157.4	3.66	183.75	3.95	232.44	4.45	287.02	4.94
"	15	30	8.92	133.8	3.87	137.57	3.93	174.24	4.42	215.37	4.91
						8″ b. to b.		9″ b. to b.		10″ b. to b.	
9	20	40	11.76	121.6	3.21	142.05	3.48	185.15	3.97	234.13	4.46
"	15	30	8.82	101.8	3.40	106.46	3.47	138.74	3.97	175.43	4.46
"	13.25	26.5	7.78	94.6	3.49	93.11	3.46	121.45	3.95	153.68	4.44
						8″ b. to b.		9″ b. to b.		10″ b. to b.	
8	16.25	32.5	9.56	79.8	2.89	116.95	3.50	152.27	3.99	192.36	4.49
"	13.75	27.5	8.08	72.0	2.98	98.88	3.50	128.72	3.99	162.60	4.49
"	11.25	22.5	6.70	64.6	3.11	81.21	3.48	105.83	3.97	133.79	4.47

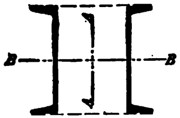


TABLE 19

TWO CHANNELS LACED, FLANGES OUTSTANDING

Size of Channel.		Total Section.		Axis BB.		Axis AA.											
						4″ b. to b.		5″ b. to b.		6″ b. to b.		7″ b. to b.		8″ b. to b.		9″ b. to b.	
Depth.	Weight.	Weight.	Area.	I	r	I	r	I	r	I	r	I	r	I	r	I	r
15	55	110.0	32.36	860.4	5.16	...	...	381.71	3.43	497.33	3.92	629.13	4.41	777.12	4.90	941.28	5.39
"	50	100.0	29.42	805.4	5.23	...	...	343.41	3.42	447.94	3.90	567.18	4.39	701.12	4.88	849.78	5.37
"	45	90.0	26.48	750.2	5.32	...	...	306.85	3.40	400.54	3.89	507.47	4.38	627.63	4.87	761.04	5.36
"	40	80.0	23.52	695.0	5.43	...	...	272.28	3.40	355.38	3.89	450.23	4.38	556.85	4.87	675.23	5.36
"	35	70.0	20.58	640.0	5.58	...	...	239.58	3.41	312.42	3.90	395.54	4.38	488.95	4.87	592.66	5.37
"	33	66.0	19.80	625.2	5.62	...	...	231.30	3.42	301.47	3.90	381.54	4.39	471.51	4.88	571.38	5.37
12	40	80.0	23.52	394.0	4.09	...	...	257.43	3.31	339.09	3.80	432.51	4.29	537.69	4.78	654.63	5.28
"	35	70.0	20.58	358.6	4.17	...	...	221.75	3.28	292.63	3.77	373.79	4.26	465.25	4.75	567.00	5.25
"	30	60.0	17.64	323.4	4.28	...	...	188.47	3.27	248.92	3.76	318.19	4.25	396.28	4.74	483.20	5.23
"	25	50.0	14.70	288.0	4.43	...	...	157.53	3.27	207.92	3.76	265.66	4.25	330.75	4.74	403.19	5.24
"	20.5	41.0	12.06	256.2	4.61	...	...	131.62	3.30	173.28	3.79	220.96	4.28	274.68	4.77	334.42	5.27
10	25	50.0	14.70	182.0	3.52	107.71	2.71	149.90	3.19	199.43	3.68	256.32	4.18	320.56	4.67	392.15	5.16
"	20	40.0	11.76	157.4	3.66	85.75	2.70	119.37	3.19	158.87	3.68	204.25	4.17	255.52	4.66	312.66	5.16
"	15	30.0	8.92	133.8	3.87	66.72	2.73	92.49	3.22	122.72	3.71	157.41	4.20	196.56	4.69	240.17	5.19
9	20	40.0	11.76	121.6	3.21	83.48	2.66	116.82	3.15	156.04	3.64	201.14	4.14	252.12	4.63	308.98	5.13
"	15	30.0	8.82	101.8	3.40	63.07	2.67	88.11	3.16	117.57	3.65	151.44	4.14	189.72	4.64	232.41	5.13
"	13.25	26.5	7.78	94.6	3.49	56.42	2.69	78.64	3.18	104.76	3.67	134.77	4.16	168.67	4.66	206.45	5.15
8	16.25	32.5	9.56	79.8	2.89	66.02	2.63	92.84	3.12	124.45	3.61	160.83	4.10	202.00	4.60	247.94	5.09
"	13.75	27.5	8.08	72.0	2.98	55.93	2.63	78.61	3.12	105.33	3.61	136.09	4.10	170.89	4.60	209.73	5.09
"	11.25	22.5	6.7a	64.6	3.11	47.12	2.65	66.05	3.14	88.34	3.63	113.97	4.12	142.96	4.62	175.29	5.11
						2″ b. to b.		3″ b. to b.		4″ b. to b.		5″ b. to b.		6″ b. to b.		7″ b. to b.	
7	14.75	29.5	8.68	54.4	2.50	...	...	38.75	2.11	58.58	2.60	82.75	3.09	111.27	3.58	144.12	4.07
"	12.25	24.5	7.20	48.4	2.59	...	...	31.99	2.11	48.39	2.59	68.40	3.08	92.00	3.57	119.20	4.07
"	9.75	19.5	5.70	42.2	2.72	...	...	25.82	2.13	38.91	2.61	54.85	3.10	73.63	3.59	95.27	4.09
6	13	26.0	7.64	34.6	2.13	...	...	33.22	2.09	50.54	2.57	71.68	3.06	96.64	3.56	125.42	4.05
"	10.5	21.0	6.18	30.2	2.21	...	...	26.55	2.07	40.48	2.56	57.49	3.05	77.59	3.54	100.79	4.04
"	8	16.0	4.76	26.0	2.34	...	...	20.77	2.09	31.56	2.57	44.73	3.07	60.28	3.56	78.21	4.05
5	9	18.0	5.30	17.8	1.83	12.90	1.56	22.08	2.04	33.90	2.53	48.38	3.02	65.50	3.52		
"	6.5	13.0	3.90	14.8	1.95	9.61	1.57	16.39	2.05	25.12	2.54	35.80	3.03	48.44	3.52		
4	5.25	10.5	3.10	7.6	1.56	7.28	1.53	12.60	2.02	19.46	2.51	27.87	3.00				

TABLE 19 (*Continued*)

TWO CHANNELS LACED, FLANGES OUTSTANDING

Size of Channel.		Total Section.		Axis AA.													
				10″ b. to b.		11″ b. to b.		12″ b. to b.		13″ b. to b.		14″ b. to b.		15″ b. to b.		16″ b. to b.	
Depth.	Weight	Weight	Area.	I	r	I	r	I	r	I	r	I	r	I	r	I	r
15	55	110.0	32.36	1121.62	5.89	1318.14	6.38	1530.85	6.87	1759.73	7.37	2004.79	7.87	2266.03	8.37	2543.45	8.87
"	50	100.0	29.42	1013.15	5.87	1191.23	6.36	1384.02	6.86	1591.52	7.35	1813.73	7.85	2050.65	8.35	2302.28	8.85
"	45	90.0	26.48	907.68	5.85	1067.57	6.35	1240.70	6.84	1427.06	7.34	1626.67	7.84	1839.52	8.33	2065.60	8.83
"	40	80.0	23.52	805.36	5.85	947.26	6.35	1100.91	6.84	1266.33	7.34	1443.51	7.83	1632.44	8.33	1833.14	8.83
"	35	70.0	20.58	706.65	5.86	830.93	6.35	965.50	6.85	1110.37	7.34	1265.52	7.84	1430.96	8.34	1606.69	8.84
"	33	66.0	19.80	681.15	5.87	800.83	6.36	930.40	6.85	1069.87	7.35	1219.24	7.85	1378.51	8.34	1547.68	8.84
12	40	80.0	23.52	783.33	5.77	923.80	6.27	1076.02	6.76	1240.00	7.26	1415.74	7.76				
"	35	70.0	20.58	679.04	5.74	801.36	6.24	933.98	6.74	1076.89	7.23	1230.09	7.73				
"	30	60.0	17.64	578.93	5.73	683.48	6.22	796.85	6.72	919.04	7.22	1050.06	7.71				
"	25	50.0	14.70	482.98	5.73	570.12	6.23	664.62	6.72	766.46	7.22	875.65	7.72				
"	20.5	41.0	12.06	400.20	5.76	472.00	6.26	549.84	6.75	633.71	7.25	723.60	7.75				
10	25	50.0	14.70	471.09	5.66	557.38	6.16	651.02	6.65								
"	20	40.0	11.76	375.68	5.65	444.58	6.15	519.36	6.64								
"	15	30.0	8.92	288.24	5.68	340.77	6.18	397.76	6.68								
9	20	40.0	11.76	371.72	5.62	440.34	6.12										
"	15	30.0	8.82	279.51	5.63	331.02	6.13										
"	13.25	26.5	7.78	248.13	5.65	293.70	6.14										
				8″ b. to b.													
7	14.75	29.5	8.68	181.31	4.57												
"	12.25	24.5	7.20	150.00	4.56												
"	9.75	19.5	5.70	119.76	4.58												

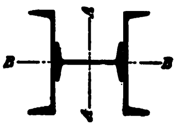


TABLE 20

TWO CHANNELS (FLANGES OUTSTANDING) AND ONE BEAM

Channel.		Beam.		Total Sec.		Axis BB.		Axis AA.	
Depth.	Weight.	Depth	Weight.	Weight.	Area.	I	r	I	r
15	55	15	42	152.00	44.84	875.02	4.42	2707.73	7.77
"	"	12	31.5	141.50	41.62	869.90	4.57	1746.65	6.48
"	"	10	25	135.00	39.73	867.29	4.67	1243.72	5.60
"	"	9	21	131.00	38.67	865.56	4.73	1026.18	5.15
"	"	8	18	128.00	37.69	864.18	4.79	834.02	4.70
"	"	7	15	125.00	36.78	863.07	4.84	665.33	4.25
"	"	6	12.25	122.25	35.97	862.25	4.90	519.13	3.80
15	50	15	42	142.00	41.90	820.02	4.42	2492.35	7.71
"	"	12	31.5	131.50	38.68	814.90	4.59	1599.82	6.43
"	"	10	25	125.00	36.79	812.29	4.70	1135.25	5.55
"	"	9	21	121.00	35.73	810.56	4.76	934.68	5.11
"	"	8	18	118.00	34.75	809.18	4.83	758.02	4.67
"	"	7	15	115.00	33.84	808.07	4.89	603.38	4.22
"	"	6	12.25	112.25	33.03	807.25	4.94	469.74	3.77
15	45	15	42	132.00	38.96	764.82	4.43	2281.22	7.65
"	"	12	31.5	121.50	35.74	759.70	4.61	1456.50	6.38
"	"	10	25	115.00	33.85	757.09	4.73	1029.78	5.52
"	"	9	21	111.00	32.79	755.36	4.80	845.94	5.08
"	"	8	18	108.00	31.81	753.98	4.87	684.53	4.64
"	"	7	15	105.00	30.90	752.87	4.94	543.67	4.19
"	"	6	12.25	102.25	30.09	752.05	5.00	422.34	3.75
15	40	15	42	122.00	36.00	709.62	4.44	2074.14	7.59
"	"	12	31.5	111.50	32.78	704.50	4.64	1316.71	6.34
"	"	10	25	105.00	30.89	701.89	4.77	927.46	5.48
"	"	9	21	101.00	29.83	700.16	4.84	760.13	5.05
"	"	8	18	98.00	28.85	698.78	4.92	613.75	4.61
"	"	7	15	95.00	27.94	697.67	5.00	486.43	4.17
"	"	6	12.25	92.25	27.13	696.85	5.07	377.18	3.73
15	35	15	42	112.00	33.06	654.62	4.45	1872.66	7.53
"	"	12	31.5	101.50	29.84	649.50	4.67	1181.30	6.29
"	"	10	25	95.00	27.95	646.89	4.81	828.75	5.45
"	"	9	21	91.00	26.89	645.16	4.90	677.56	5.02
"	"	8	18	88.00	25.91	643.78	4.98	545.85	4.59
"	"	7	15	85.00	25.00	642.67	5.07	431.74	4.16
"	"	6	12.25	82.25	24.19	641.85	5.15	334.22	3.72

TWO CHANNELS (FLANGES OUTSTANDING) AND ONE BEAM

Channel.		Beam.		Total Sec.		Axis BB.		Axis AA.	
Depth.	Weight.	Depth.	Weight.	Weight.	Area.	I	r	I	r
15	33	15	42	108.00	32.28	639.82	4.45	1820.21	7.51
"	"	12	31.5	97.50	29.06	634.70	4.67	1146.20	6.28
"	"	10	25	91.00	27.17	632.09	4.82	803.25	5.44
"	"	9	21	87.00	26.11	630.36	4.91	656.28	5.01
"	"	8	18	84.00	25.13	628.98	5.00	528.41	4.59
"	"	7	15	81.00	24.22	627.87	5.09	417.74	4.15
"	"	6	12.25	78.25	23.41	627.05	5.18	323.27	3.72
12	40	12	31.5	111.50	32.78	403.50	3.51	1291.82	6.28
"	"	10	25	105.00	30.89	400.89	3.60	905.43	5.41
"	"	9	21	101.00	29.83	399.16	3.66	739.53	4.98
"	"	8	18	98.00	28.85	397.78	3.71	594.59	4.54
"	"	7	15	95.00	27.94	396.67	3.77	468.71	4.10
"	"	6	12.25	92.25	27.13	395.85	3.82	360.89	3.65
12	35	12	31.5	101.50	29.84	368.10	3.51	1149.78	6.21
"	"	10	25	95.00	27.95	365.49	3.62	801.14	5.35
"	"	9	21	91.00	26.89	363.76	3.68	651.90	4.92
"	"	8	18	88.00	25.91	362.38	3.74	522.15	4.49
"	"	7	15	85.00	25.00	361.27	3.80	409.99	4.05
"	"	6	12.25	82.25	24.19	360.45	3.86	314.43	3.61
12	30	12	31.5	91.50	26.90	332.90	3.52	1012.65	6.14
"	"	10	25	85.00	25.01	330.29	3.63	701.03	5.29
"	"	9	21	81.00	23.95	328.56	3.70	568.10	4.87
"	"	8	18	78.00	22.97	327.18	3.77	453.18	4.44
"	"	7	15	75.00	22.06	326.07	3.84	354.39	4.01
"	"	6	12.25	72.25	21.25	325.25	3.91	270.72	3.57
12	25	12	31.5	81.50	23.96	297.50	3.52	880.42	6.06
"	"	10	25	75.00	22.07	294.89	3.66	605.08	5.24
"	"	9	21	71.00	21.01	293.16	3.74	488.09	4.82
"	"	8	18	68.00	20.03	291.78	3.82	387.65	4.40
"	"	7	15	65.00	19.12	290.67	3.90	301.86	3.97
"	"	6	12.25	62.25	18.31	289.85	3.98	229.72	3.54
12	20.5	12	31.5	72.50	21.32	265.70	3.53	765.64	5.99
"	"	10	25	66.00	19.43	263.09	3.68	522.30	5.18
"	"	9	21	62.00	18.37	261.36	3.77	419.32	4.78
"	"	8	18	59.00	17.39	259.98	3.87	331.58	4.37
"	"	7	15	56.00	16.48	258.87	3.96	257.16	3.95
"	"	6	12.25	53.25	15.67	258.05	4.06	195.08	3.53

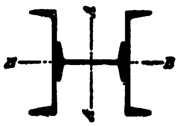


TABLE 20 (*Continued*)

TWO CHANNELS (FLANGES OUTSTANDING) AND ONE BEAM

Channel.		Beam.		Total Sec.		Axis BB.		Axis AA.	
Depth.	Weight.	Depth.	Weight.	Weight.	Area.	I	r	I	r
10	25	12	31.5	81.50	23.96	191.50	2.83	866.82	6.01
“	“	10	25	75.00	22.07	188.89	2.93	593.19	5.18
“	“	9	21	71.00	21.01	187.16	2.98	477.05	4.77
“	“	8	18	68.00	20.03	185.78	3.05	377.46	4.34
“	“	7	15	65.00	19.12	184.67	3.11	292.52	3.91
“	“	6	12.25	62.25	18.31	183.85	3.17	221.23	3.48
10	20	12	31.5	71.50	21.02	166.90	2.82	735.16	5.91
“	“	10	25	65.00	19.13	164.29	2.93	497.78	5.10
“	“	9	21	61.00	18.07	162.56	3.00	397.56	4.69
“	“	8	18	58.00	17.09	161.18	3.07	312.42	4.28
“	“	7	15	55.00	16.18	160.07	3.15	240.45	3.86
“	“	6	12.25	52.25	15.37	159.25	3.22	180.67	3.43
10	15	12	31.5	61.50	18.18	143.30	2.81	613.56	5.81
“	“	10	25	55.00	16.29	140.69	2.94	410.34	5.02
“	“	9	21	51.00	15.23	138.96	3.02	325.07	4.62
“	“	8	18	48.00	14.25	137.58	3.11	253.46	4.22
“	“	7	15	45.00	13.34	136.47	3.20	193.61	3.81
“	“	6	12.25	42.25	12.53	135.65	3.29	144.52	3.40
9	20	10	25	65.00	19.13	128.49	2.59	493.82	5.08
“	“	9	21	61.00	18.07	126.76	2.65	393.88	4.67
“	“	8	18	58.00	17.09	125.38	2.71	309.02	4.25
“	“	7	15	55.00	16.18	124.27	2.77	237.34	3.83
“	“	6	12.25	52.25	15.37	123.45	2.83	177.84	3.40
9	15	10	25	55.00	16.19	108.69	2.59	401.61	4.98
“	“	9	21	51.00	15.13	106.96	2.66	317.31	4.58
“	“	8	18	48.00	14.15	105.58	2.73	246.62	4.17
“	“	7	15	45.00	13.24	104.47	2.81	187.64	3.76
“	“	6	12.25	42.25	12.43	103.65	2.89	139.37	3.35
9	13.25	10	25	51.50	15.15	101.49	2.59	370.23	4.94
“	“	9	21	47.50	14.09	99.76	2.66	291.35	4.55
“	“	8	18	44.50	13.11	98.38	2.74	225.57	4.15
“	“	7	15	41.50	12.20	97.27	2.82	170.97	3.74
“	“	6	12.25	38.75	11.39	96.45	2.91	126.56	3.33

TWO CHANNELS (FLANGES OUTSTANDING) AND ONE BEAM

Channel.		Beam.		Total Sec.		Axis BB.		Axis AA.	
Depth.	Weight.	Depth.	Weight.	Weight.	Area.	I	r	I	r
8	16.25	9	21	53.50	15.87	84.96	2.31	332.84	4.58
"	"	8	18	50.50	14.89	83.58	2.37	258.90	4.17
"	"	7	15	47.50	13.98	82.47	2.43	197.03	3.75
"	"	6	12.25	44.75	13.17	81.65	2.49	146.25	3.33
8	13.75	9	21	48.50	14.39	77.16	2.32	294.63	4.52
"	"	8	18	45.50	13.41	75.78	2.38	227.79	4.12
"	"	7	15	42.50	12.50	74.67	2.44	172.29	3.71
"	"	6	12.25	39.75	11.69	73.85	2.51	127.13	3.30
8	11.25	9	21	43.50	13.01	69.76	2.32	260.19	4.47
"	"	8	18	40.50	12.03	68.38	2.38	199.86	4.08
"	"	7	15	37.50	11.12	67.27	2.46	150.17	3.67
"	"	6	12.25	34.75	10.31	66.45	2.54	110.14	3.27
7	14.75	8	18	47.50	14.01	58.18	2.04	238.21	4.12
"	"	7	15	44.50	13.10	57.07	2.09	180.32	3.71
"	"	6	12.25	41.75	12.29	56.25	2.14	133.07	3.29
7	12.25	8	18	42.50	12.53	52.18	2.04	206.90	4.06
"	"	7	15	39.50	11.62	51.07	2.10	155.40	3.66
"	"	6	12.25	36.75	10.81	50.25	2.16	113.80	3.24
7	9.75	8	18	37.50	11.03	45.98	2.04	176.66	4.00
"	"	7	15	34.50	10.12	44.87	2.11	131.47	3.60
"	"	6	12.25	31.75	9.31	44.05	2.18	95.43	3.20
6	13	7	15	41.00	12.06	37.27	1.76	161.62	3.66
"	"	6	12.25	38.25	11.25	36.45	1.80	118.44	3.24
6	10.5	7	15	36.00	10.60	32.87	1.76	136.99	3.59
"	"	6	12.25	33.25	9.79	32.05	1.81	99.39	3.19
6	8	7	15	31.00	9.18	28.67	1.77	114.41	3.53
"	"	6	12.25	28.25	8.37	27.85	1.82	82.08	3.13

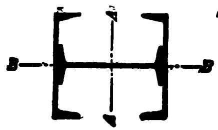


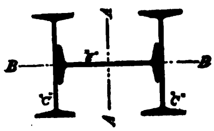
TABLE 21

TWO CHANNELS (FLANGES IN) AND ONE BEAM

Beam.		Channel.		Total Section.		Axis AA.		Axis BB.	
Depth.	Weight.	Depth.	Weight.	Weight.	Area.	I	r	I	r
15	42	15	50	142	41.90	2082.59	7.05	820.02	4.42
"	"	15	45	132	38.96	1886.57	6.96	764.82	4.43
"	"	15	40	122	36.00	1693.68	6.86	709.62	4.44
"	"	15	35	112	33.06	1506.94	6.75	654.62	4.45
"	"	15	33	108	32.28	1457.97	6.72	639.82	4.45
15	42	12	40	122	36.00	1790.69	7.07	408.62	3.37
"	"	12	35	112	33.06	1593.29	6.94	373.22	3.36
"	"	12	30	102	30.12	1401.45	6.82	338.02	3.35
"	"	12	25	92	27.18	1215.35	6.69	302.62	3.34
"	"	12	20.5	83	24.54	1053.36	6.55	270.82	3.32
12	31.5	15	50	131.5	38.68	1268.26	5.73	814.90	4.59
"	"	15	45	121.5	35.74	1137.64	5.64	759.70	4.61
"	"	15	40	111.5	32.78	1009.78	5.55	704.50	4.64
"	"	15	35	101.5	29.84	886.71	5.45	649.50	4.67
"	"	15	33	97.5	29.06	854.52	5.42	634.70	4.67
12	31.5	12	40	111.5	32.78	1085.97	5.76	403.50	3.51
"	"	12	35	101.5	29.84	954.23	5.66	368.10	3.51
"	"	12	30	91.5	26.90	827.02	5.54	332.90	3.52
"	"	12	25	81.5	23.96	704.48	5.42	297.50	3.52
"	"	12	20.5	72.5	21.32	598.59	5.30	265.70	3.53
"	"	10	25	81.5	23.96	735.87	5.54	191.50	2.83
"	"	10	20	71.5	21.02	613.43	5.40	166.90	2.82
"	"	10	15	61.5	18.18	500.23	5.25	143.30	2.81

Beam.		Channel.		Total Section.		Axis AA.		Axis BB.	
Depth.	Weight.	Depth.	Weight.	Weight.	Area.	I	r	I	r
10	25	12	40	105	30.89	731.86	4.87	400.89	3.60
"	"	12	35	95	27.95	636.53	4.77	365.49	3.62
"	"	12	30	85	25.01	545.06	4.67	330.29	3.63
"	"	12	25	75	22.07	457.54	4.55	294.89	3.66
"	"	12	20.5	66	19.43	382.45	4.44	263.09	3.68
"	"	10	25	75	22.07	483.14	4.68	188.89	2.93
"	"	10	20	65	19.13	395.71	4.55	164.29	2.93
"	"	10	15	55	16.29	315.53	4.40	140.69	2.94
"	"	9	15	55	16.19	320.67	4.45	108.69	2.59
"	"	9	13.25	51.5	15.15	291.92	4.39	101.49	2.59
9	21	10	25	71	21.01	377.46	4.24	187.16	2.98
"	"	10	20	61	18.07	305.32	4.11	162.56	3.00
"	"	10	15	51	15.23	239.52	3.97	138.96	3.02
"	"	9	15	51	15.13	244.24	4.02	106.96	2.66
"	"	9	13.25	47.5	14.09	220.69	3.96	99.76	2.66
"	"	8	13.75	48.5	14.39	233.95	4.03	77.16	2.32
"	"	8	11.25	43.5	13.01	202.62	3.95	69.76	2.32
8	18	8	11.25	40.5	12.03	148.53	3.51	68.38	2.38
"	"	7	9.75	37.5	11.03	135.38	3.50	45.98	2.04
"	"	6	8	34	10.09	122.87	3.49	29.78	1.72
7	15	7	9.75	34.5	10.12	95.22	3.07	44.87	2.11
"	"	6	8	31	9.18	85.83	3.06	28.67	1.77

TABLE 22



THREE BEAMS

Beam "C."		Beam "E."		Total Section.		Axis BB.		Axis AA.	
Depth.	Weight.	Depth.	Weight.	Weight.	Area.	I	r	I	r
15	60	20	65	185	54.42	1245.86	4.79	4967.10	9.55
"	"	18	55	175	51.27	1239.19	4.92	3900.79	8.72
"	"	15	42	162	47.82	1232.62	5.08	2640.95	7.43
"	"	12	31.5	151.5	44.60	1227.50	5.25	1668.14	6.12
15	50	20	65	165	48.50	994.66	4.53	4310.13	9.43
"	"	18	55	155	45.35	987.99	4.67	3360.74	8.61
"	"	15	42	142	41.90	981.42	4.84	2254.07	7.33
"	"	12	31.5	131.5	38.68	976.30	5.02	1407.79	6.03
15	45	20	65	155	45.56	939.46	4.54	3970.81	9.34
"	"	18	55	145	42.41	932.79	4.69	3081.51	8.52
"	"	15	42	132	38.96	926.22	4.88	2053.96	7.26
"	"	12	31.5	121.5	35.74	921.10	5.08	1273.57	5.97
15	42	20	65	149	44.04	911.26	4.55	3798.22	9.29
"	"	18	55	139	40.89	904.59	4.70	2939.75	8.48
"	"	15	42	126	37.44	898.02	4.90	1952.74	7.22
"	"	12	31.5	115.5	34.22	892.90	5.11	1206.05	5.94
12	40	18	55	135	39.61	558.99	3.76	2840.59	8.47
"	"	15	42	122	36.16	552.42	3.91	1884.27	7.22
"	"	12	31.5	111.5	32.94	547.30	4.08	1162.51	5.94
12	35	18	55	125	36.51	477.79	3.62	2564.45	8.38
"	"	15	42	112	33.06	471.22	3.78	1687.74	7.14
"	"	12	31.5	101.5	29.84	466.10	3.95	1031.64	5.88
12	31.5	18	55	118	34.45	452.79	3.63	2373.63	8.30
"	"	15	42	105	31.00	446.22	3.79	1551.63	7.07
"	"	12	31.5	94.5	27.78	441.10	3.98	940.98	5.82
10	30	18	55	115	33.57	289.59	2.94	2312.89	8.30
"	"	15	42	102	30.12	283.02	3.07	1510.36	7.08
"	"	12	31.5	91.5	26.90	277.90	3.21	915.21	5.83
10	25	18	55	105	30.67	265.39	2.94	2044.80	8.17
"	"	15	42	92	27.22	258.82	3.09	1319.23	6.96
"	"	12	31.5	81.5	24.00	253.70	3.25	787.99	5.73

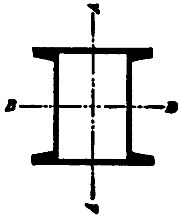


TABLE 23

TWO CHANNELS AND

Thickness of Pls.					5/16		3/8		7/16		1/2	
Area of 2-18″ Pls.					11.25		13.50		15.75		18.00	
Section. Channel.	Section. Plate.	Area of 2 [s	B. to B. of [s	Axis.	I	r	I	r	I	r	I	r
15″ 55#	18″	32.36	10.5	BB	1519.94	5.90	1658.37	6.01	1799.02	6.12	1941.90	6.21
				AA	1521.61	5.91	1582.36	5.87	1643.11	5.84	1703.86	5.82
15″ 50#	18″	29.42	10.5	BB	1464.94	6.00	1603.37	6.11	1744.02	6.21	1886.90	6.31
				AA	1404.10	5.88	1464.85	5.84	1525.60	5.81	1586.35	5.78
15″ 45#	18″	26.48	10.75	BB	1409.74	6.11	1548.17	6.22	1688.82	6.32	1831.70	6.42
				AA	1330.11	5.94	1390.86	5.90	1451.61	5.86	1512.36	5.83
15″ 40#	18″	23.52	11	BB	1354.54	6.24	1492.97	6.35	1633.62	6.45	1776.50	6.54
				AA	1251.01	6.00	1311.76	5.95	1372.51	5.91	1433.26	5.88
15″ 35#	18″	20.58	11.25	BB	1299.54	6.39	1437.97	6.50	1578.62	6.59	1721.50	6.68
				AA	1167.36	6.06	1228.11	6.00	1288.86	5.96	1349.61	5.91
15″ 33#	18″	19.80	11.25	BB	1284.74	6.43	1423.17	6.54	1563.82	6.63	1706.70	6.72
				AA	1136.04	6.05	1196.79	5.99	1257.54	5.95	1318.29	5.91
Thickness of Pls.					5/16		3/8		7/16		1/2	
Area of 2-16″ Pls.					10.00		12.00		14.00		16.00	
15″ 55#	16″	32.36	8.5	BB	1446.66	5.84	1569.71	5.95	1694.73	6.05	1821.73	6.14
				AA	1070.51	5.03	1113.18	5.01	1155.84	4.99	1198.51	4.98
15″ 50#	16″	29.42	8.5	BB	1391.66	5.94	1514.71	6.05	1639.73	6.15	1766.73	6.24
				AA	986.95	5.00	1029.62	4.99	1072.28	4.97	1114.95	4.95
15″ 45#	16″	26.48	8.75	BB	1336.46	6.05	1459.51	6.16	1584.53	6.26	1711.53	6.35
				AA	939.78	5.08	982.45	5.05	1025.11	5.03	1067.78	5.01
15″ 40#	16″	23.52	9	BB	1281.26	6.18	1404.31	6.29	1529.33	6.38	1656.33	6.47
				AA	888.56	5.15	931.23	5.12	973.89	5.09	1016.56	5.07
15″ 35#	16″	20.58	9.25	BB	1226.26	6.33	1349.31	6.44	1474.33	6.53	1601.33	6.62
				AA	833.52	5.22	876.19	5.19	918.85	5.15	961.52	5.13
15″ 33#	16″	19.80	9.25	BB	1211.46	6.38	1334.51	6.48	1459.53	6.57	1586.53	6.66
				AA	811.23	5.22	853.90	5.18	896.56	5.15	939.23	5.12
Thickness of Pls.					1/4		5/16		3/8		7/16	
Area of 2-16″ Pls.					8.00		10.00		12.00		14.00	
12″ 40#	16″	23.52	8.75	BB	694.17	4.69	773.07	4.80	853.56	4.90	935.64	4.99
				AA	794.96	5.02	837.63	5.00	880.30	4.98	922.96	4.96
12″ 35#	16″	20.58	9	BB	658.77	4.80	737.67	4.91	818.16	5.01	900.24	5.10
				AA	737.67	5.08	780.33	5.05	823.00	5.03	865.67	5.00
12″ 30#	16″	17.64	9.25	BB	623.57	4.93	702.47	5.04	782.96	5.14	865.04	5.23
				AA	676.97	5.14	719.63	5.10	762.30	5.07	804.97	5.04
12″ 25#	16″	14.70	9.5	BB	588.17	5.09	667.07	5.20	747.56	5.29	829.64	5.38
				AA	612.83	5.20	655.50	5.15	698.17	5.11	740.83	5.08
12″ 20.5	16″	12.06	9.75	BB	556.37	5.27	635.27	5.37	715.76	5.45	797.84	5.53
				AA	553.86	5.25	596.52	5.20	639.19	5.15	681.86	5.12
Thickness of Pls.					1/4		5/16		3/8		7/16	
Area of 2-14″ Pls.					7.00		8.75		10.50		12.25	
12″ 40#	14″	23.52	6.75	BB	656.65	4.64	725.69	4.74	796.12	4.83	867.94	4.93
				AA	522.39	4.14	550.97	4.13	579.55	4.13	608.13	4.12
12″ 35#	14″	20.58	7	BB	621.25	4.75	690.29	4.85	760.72	4.95	832.54	5.04
				AA	488.13	4.21	516.71	4.20	545.29	4.19	573.88	4.18

TWO COVER PLATES

9/16		5/8		11/16		3/4		7/8		1			
20.25		22.50		24.75		27.00		31.50		36.00			
I	r	I	r	I	r	I	r	I	r	I	r		
2087.03	6.30	2234.42	6.38	2384.10	6.46	2536.09	6.54	2847.03	6.68	3167.40	6.81		
1764.61	5.79	1825.36	5.77	1886.11	5.75	1946.86	5.73	2068.36	5.69	2189.86	5.66		
2032.03	6.40	2179.42	6.48	2329.10	6.56	2481.09	6.63	2792.03	6.77	3112.40	6.90		
1647.10	5.76	1707.85	5.74	1768.60	5.71	1829.35	5.69	1950.85	5.66	2072.35	5.63		
1976.83	6.50	2124.22	6.59	2273.90	6.66	2425.89	6.74	2736.83	6.87	3057.20	7.00		
1573.11	5.80	1633.86	5.78	1694.61	5.75	1755.36	5.73	1876.86	5.69	1998.36	5.66		
1921.63	6.63	2069.02	6.71	2218.70	6.78	2370.69	6.85	2681.63	6.98	3002.00	7.10		
1494.01	5.84	1554.76	5.81	1615.51	5.79	1676.26	5.76	1797.76	5.72	1919.26	5.68		
1866.63	6.76	2014.02	6.84	2163.70	6.91	2315.69	6.98	2626.63	7.10	2947.00	7.22		
1410.36	5.88	1471.11	5.84	1531.86	5.81	1592.61	5.79	1714.11	5.74	1835.61	5.70		
1851.83	6.80	1999.22	6.87	2148.90	6.95	2300.89	7.01	2611.83	7.14	2932.20	7.25		
1379.04	5.87	1439.79	5.83	1500.54	5.80	1561.29	5.78	1682.79	5.73	1804.29	5.69		
9/16		5/8		11/16		3/4		7/8		1			
18.00		20.00		22.00		24.00		28.00		32.00			
1950.74	6.22	2081.75	6.31	2214.80	6.38	2349.90	6.46	2626.30	6.60	2911.07	6.73		
1241.18	4.96	1283.84	4.95	1326.51	4.94	1369.18	4.93	1454.51	4.91	1539.84	4.89		
1895.74	6.32	2026.75	6.40	2159.80	6.48	2294.90	6.55	2571.30	6.69	2856.07	6.82		
1157.62	4.94	1200.28	4.93	1242.95	4.92	1285.62	4.91	1370.95	4.89	1456.28	4.87		
1840.54	6.43	1971.55	6.51	2104.60	6.59	2239.70	6.66	2516.10	6.80	2800.87	6.92		
1110.45	5.00	1153.11	4.98	1195.78	4.97	1238.45	4.95	1323.78	4.93	1409.11	4.91		
1785.34	6.56	1916.35	6.64	2049.40	6.71	2184.50	6.78	2460.90	6.91	2745.67	7.03		
1059.23	5.05	1101.89	5.03	1144.56	5.01	1187.23	5.00	1272.56	4.97	1357.89	4.95		
1730.34	6.70	1861.35	6.77	1994.40	6.84	2129.50	6.91	2405.90	7.04	2690.67	7.15		
1004.19	5.10	1046.85	5.08	1089.52	5.06	1132.19	5.04	1217.52	5.01	1302.85	4.98		
1715.54	6.74	1846.55	6.81	1979.60	6.88	2114.70	6.95	2391.10	7.07	2675.87	7.19		
981.90	5.10	1024.56	5.07	1067.23	5.05	1109.90	5.03	1195.23	5.00	1280.56	4.97		
1/2		9/16		5/8		11/16		3/4		7/8		1	
16.00		18.00		20.00		22.00		24.00		28.00		32.00	
1019.33	5.08	1104.65	5.16	1191.60	5.23	1280.21	5.30	1370.50	5.37	1556.14	5.50	1748.67	5.61
965.63	4.94	1008.30	4.93	1050.96	4.91	1093.63	4.90	1136.30	4.89	1221.63	4.87	1306.96	4.85
983.93	5.19	1069.25	5.26	1156.20	5.34	1244.81	5.41	1335.10	5.47	1520.74	5.59	1713.27	5.71
908.33	4.98	951.00	4.96	993.67	4.95	1036.33	4.93	1079.00	4.92	1164.33	4.90	1249.67	4.88
948.73	5.31	1034.05	5.39	1121.00	5.46	1209.61	5.52	1299.90	5.59	1485.54	5.71	1678.07	5.81
847.63	5.02	890.30	5.00	932.97	4.98	975.63	4.96	1018.30	4.95	1103.63	4.92	1188.97	4.89
913.33	5.45	998.65	5.53	1085.60	5.59	1174.21	5.66	1264.50	5.72	1450.14	5.83	1642.67	5.93
783.50	5.05	826.17	5.03	868.83	5.00	911.50	4.98	954.17	4.97	1039.50	4.93	1124.83	4.91
881.53	5.60	966.85	5.67	1053.80	5.73	1142.41	5.79	1232.70	5.85	1418.34	5.95	1610.87	6.05
724.52	5.08	767.19	5.05	809.86	5.03	852.52	5.00	895.19	4.98	980.52	4.95	1065.86	4.92
1/2		9/16		5/8		11/16		3/4		7/8		1	
14.00		15.75		17.50		19.25		21.00		24.50		28.00	
941.17	5.01	1015.82	5.09	1091.90	5.16	1169.44	5.23	1248.44	5.30	1410.88	5.42	1579.33	5.54
636.72	4.12	665.30	4.12	693.88	4.11	722.47	4.11	751.05	4.11	808.22	4.10	865.39	4.10
905.77	5.12	980.42	5.19	1056.50	5.27	1134.04	5.34	1213.04	5.40	1375.48	5.52	1543.93	5.64
602.46	4.17	631.04	4.17	659.63	4.16	688.21	4.16	716.79	4.15	773.96	4.14	831.13	4.14

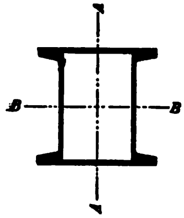


TABLE 23 (*Continued*)

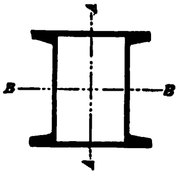
TWO CHANNELS AND

Section. Channel.	Plate.	Area of 2 [s	B. to B of [s	Axis.	I	r	I	r	I	r	I	r
Thickness of Pls.					¼		5/16		⅜		7/16	
Area of 2-14″ Pls.					7.00		8.75		10.50		12.25	
12″ 30#	14″	17.64	7.25	BB	586.05	4.88	655.09	4.98	725.52	5.08	797.34	5.16
				AA	451.22	4.28	479.80	4.26	508.39	4.25	536.97	4.24
12″ 25#	14″	14.70	7.5	BB	550.65	5.04	619.69	5.14	690.12	5.23	761.94	5.32
				AA	411.62	4.36	440.20	4.33	468.79	4.31	497.37	4.30
12″ 20.5#	14″	12.06	7.75	BB	518.85	5.22	587.89	5.32	658.32	5.40	730.14	5.48
				AA	375.02	4.44	403.60	4.40	432.18	4.38	460.77	4.35
Thickness of Pls.					¼		5/16		⅜		7/16	
Area of 2-14″ Pls.					7.00		8.75		10.50		12.25	
10″ 25#	14″	14.70	8	BB	365.89	4.11	414.70	4.21	464.68	4.29	515.83	4.37
				AA	434.89	4.48	463.48	4.45	492.06	4.42	520.64	4.40
10″ 20#	14″	11.76	3.25	BB	341.29	4.27	390.10	4.36	440.08	4.45	491.23	4.52
				AA	383.58	4.52	412.17	4.48	440.75	4.45	469.33	4.42
10″ 15#	14″	8.92	8.5	BB	317.69	4.47	366.50	4.55	416.48	4.63	467.63	4.70
				AA	332.14	4.57	360.72	4.52	389.31	4.48	417.89	4.44
Thickness of Pls.					¼		5/16		⅜		7/16	
Area of 2-12″ Pls.					6.00		7.50		9.00		10.50	
10″ 25#	12″	14.70	6	BB	339.62	4.05	381.46	4.15	424.30	4.23	468.14	4.31
				AA	271.43	3.62	289.43	3.61	307.43	3.60	325.43	3.59
10″ 20#	12″	11.76	6.25	BB	315.02	4.21	356.86	4.30	399.70	4.39	443.54	4.46
				AA	241.67	3.69	259.67	3.67	277.67	3.66	295.67	3.64
10″ 15#	12″	8.92	6.5	BB	291.42	4.42	333.26	4.51	376.10	4.58	419.94	4.65
				AA	211.51	3.77	229.51	3.74	247.51	3.72	265.51	3.70
Thickness of Pls.					¼		5/16		⅜		7/16	
Area of 2-12″ Pls.					6.00		7.50		9.00		10.50	
9″ 20#	12″	11.76	6.25	BB	249.97	3.75	284.26	3.84	319.46	3.92	355.57	4.00
				AA	238.77	3.67	256.77	3.65	274.77	3.64	292.77	3.63
9″ 15#	12″	8.82	6.5	BB	230.17	3.94	264.46	4.03	299.66	4.10	335.77	4.17
				AA	205.96	3.73	223.96	3.70	241.96	3.68	259.96	3.67
9″ 13.25	12″	7.78	6.75	BB	222.97	4.02	257.26	4.10	292.46	4.17	328.57	4.24
				AA	198.90	3.80	216.90	3.77	234.90	3.74	252.90	3.72
Thickness of Pls.					¼		5/16		⅜		7/16	
Area of 2-11″ Pls.					5.50		6.88		8.25		9.63	
9″ 20#	11″	11.76	5.25	BB	239.28	3.72	270.71	3.81	302.97	3.89	336.07	3.96
				AA	181.53	3.24	195.40	3.24	209.26	3.23	223.13	3.23
9″ 15#	11″	8.82	5.50	BB	219.48	3.91	250.91	4.00	283.17	4.07	316.27	4.14
				AA	157.75	3.32	171.61	3.31	185.48	3.30	199.34	3.29
9″ 13.25	11″	7.78	5.75	BB	212.28	4.00	243.71	4.08	275.97	4.15	309.07	4.21
				AA	153.33	3.40	167.19	3.38	181.05	3.36	194.92	3.35
Thickness of Pls.					¼		5/16		⅜		7/16	
Area of 2-12″ Pls.					6.00		7.50		9.00		10.50	
8″ 16.25	12″	9.56	6.50	BB	181.92	3.42	209.42	3.50	237.72	3.58	266.84	3.65
				AA	214.04	3.71	232.04	3.69	250.04	3.67	268.04	3.66

TWO COVER PLATES

1/2		9/16		5/8		11/16		3/4		7/8		1	
14.00		15.75		17.50		19.25		21.00		24.50		28.00	
I	r	I	r	I	r	I	r	I	r	I	r	I	r
870.57	5.25	945.22	5.32	1021.30	5.39	1098.84	5.46	1177.84	5.52	1340.28	5.64	1508.73	5.75
565.55	4.23	594.14	4.22	622.72	4.21	651.30	4.20	679.89	4.19	737.05	4.18	794.22	4.17
835.17	5.39	909.82	5.47	985.90	5.53	1063.44	5.60	1142.44	5.66	1304.88	5.77	1473.33	5.87
525.95	4.28	554.54	4.27	583.12	4.26	611.70	4.24	640.29	4.23	697.45	4.22	754.62	4.20
803.37	5.55	878.02	5.62	954.10	5.68	1031.64	5.74	1110.64	5.80	1273.08	5.90	1441.53	6.00
489.35	4.33	517.93	4.32	546.52	4.30	575.10	4.29	603.68	4.27	660.85	4.25	718.02	4.23
1/2		9/16		5/8		11/16		3/4					
14.00		15.75		17.50		19.25		21.00					
568.17	4.45	621.71	4.52	676.46	4.58	732.45	4.64	789.69	4.70				
549.23	4.37	577.81	4.36	606.39	4.34	634.98	4.32	663.56	4.31				
543.57	4.59	597.11	4.66	651.86	4.72	707.85	4.78	765.09	4.83				
497.92	4.40	526.50	4.37	555.08	4.36	583.67	4.34	612.25	4.32				
519.97	4.76	573.51	4.82	628.26	4.88	684.25	4.93	741.49	4.98				
446.47	4.41	475.06	4.39	503.64	4.37	532.22	4.35	560.81	4.33				
1/2		9/16		5/8		11/16		3/4					
12.00		13.50		15.00		16.50		18.00					
513.00	4.38	558.89	4.45	605.83	4.52	653.82	4.58	702.87	4.64				
343.43	3.59	361.43	3.58	379.43	3.57	397.43	3.57	415.43	3.56				
488.40	4.53	534.29	4.60	581.23	4.66	629.22	4.72	678.27	4.77				
313.67	3.63	331.67	3.62	349.67	3.61	367.67	3.61	385.67	3.60				
464.80	4.71	510.69	4.77	557.63	4.83	605.62	4.88	654.67	4.93				
283.51	3.68	301.51	3.67	319.51	3.65	337.51	3.64	355.51	3.63				
1/2		9/16		5/8		11/16		3/4					
12.00		13.50		15.00		16.50		18.00					
392.60	4.06	430.57	4.13	469.49	4.19	509.37	4.25	550.22	4.30				
310.77	3.62	328.77	3.61	346.77	3.60	364.77	3.59	382.77	3.59				
372.80	4.23	410.77	4.29	449.69	4.34	489.57	4.40	530.42	4.45				
277.96	3.65	295.96	3.64	313.96	3.63	331.96	3.62	349.96	3.61				
365.60	4.30	403.57	4.35	442.49	4.41	482.37	4.46	523.22	4.51				
270.90	3.70	288.90	3.68	306.90	3.67	324.90	3.66	342.90	3.65				
1/2		9/16		5/8		11/16		3/4					
11.00		12.38		13.75		15.13		16.50					
370.02	4.03	404.82	4.10	440.50	4.16	477.06	4.21	514.50	4.27				
236.99	3.23	250.86	3.22	264.72	3.22	278.59	3.22	292.45	3.22				
350.22	4.20	385.02	4.26	420.70	4.32	457.26	4.37	494.70	4.42				
213.21	3.28	227.07	3.27	240.94	3.27	254.80	3.26	268.67	3.26				
343.02	4.27	377.82	4.33	413.50	4.38	450.06	4.43	487.50	4.48				
208.78	3.33	222.65	3.32	236.51	3.31	250.38	3.31	264.24	3.30				
1/2		9/16		5/8									
12.00		13.50		15.00									
296.80	3.71	327.60	3.77	359.25	3.82								
286.04	3.64	304.04	3.63	322.04	3.62								

TABLE 23 (*Continued*)



TWO CHANNELS AND

Channel	Plate	Area of 2 [s.	B. to B. of [s.	Axis	I	r	I	r	I	r
Thickness of Pls.					1/4		5/16		3/8	
Area of 2-12″ Pls.					6.00		7.50		9.00	
8″ 13.75	12″	8.08	6.75	BB	174.12	3.52	201.62	3.60	229.92	3.67
				AA	200.02	3.77	218.02	3.74	236.02	3.72
8″ 11.25	12″	6.70	7	BB	166.72	3.62	194.22	3.70	222.52	3.76
				AA	185.97	3.83	203.97	3.79	221.97	3.76
Thickness of Pls.					1/4		5/16		3/8	
Area of 2-10″ Pls.					5.00		6.25		7.50	
8″ 16.25	10″	9.56	4.50	BB	164.90	3.37	187.82	3.45	211.40	3.52
				AA	120.50	2.88	130.91	2.88	141.33	2.88
8″ 13.75	10″	8.08	4.75	BB	157.10	3.47	180.02	3.54	203.60	3.61
				AA	114.23	2.96	124.64	2.95	135.06	2.94
8″ 11.25	10″	6.70	5	BB	149.70	3.58	172.62	3.65	196.20	3.72
				AA	107.72	3.03	118.14	3.02	128.55	3.01
Thickness of Pls.					1/4		5/16		3/8	
Area of 2-10″ Pls.					5.00		6.25		7.50	
7″ 14.75	10″	8.68	4.75	BB	120.13	2.96	138.00	3.04	156.47	3.11
				AA	117.97	2.94	128.39	2.93	138.80	2.93
7″ 12.25	10″	7.20	5	BB	114.13	3.06	132.00	3.13	150.47	3.20
				AA	110.06	3.00	120.48	2.99	130.90	2.98
7″ 9.75	10″	5.70	5.25	BB	107.93	3.18	125.80	3.24	144.27	3.31
				AA	100.94	3.07	111.36	3.05	121.77	3.04
Thickness of Pls.					1/4		5/16		3/8	
Area of 2-9″ Pls.					4.50		5.63		6.75	
7″ 14.75	9″	8.68	3.75	BB	113.55	2.94	129.64	3.01	146.26	3.08
				AA	83.59	2.52	91.18	2.52	98.78	2.53
7″ 12.25	9″	7.20	4	BB	107.55	3.03	123.64	3.10	140.26	3.17
				AA	78.77	2.59	86.36	2.59	93.96	2.60
7″ 9.75	9″	5.70	4.25	BB	101.35	3.15	117.44	3.22	134.06	3.28
				AA	73.00	2.68	80.59	2.67	88.19	2.66
Thickness of Pls.					1/4		5/16		3/8	
Area of 2-10″ Pls.					5.00		6.25		7.50	
6″ 13#	10″	7.64	5	BB	83.45	2.57	96.91	2.64	110.89	2.71
				AA	113.35	2.99	123.76	2.98	134.18	2.98
6″ 10.5#	10″	6.18	5.25	BB	79.05	2.66	92.51	2.73	106.49	2.79
				AA	103.89	3.05	114.31	3.03	124.73	3.02
6″ 8#	10″	4.76	5.5	BB	74.85	2.77	88.31	2.83	102.29	2.89
				AA	93.87	3.10	104.29	3.08	114.70	3.06
Thickness of Pls.					1/4		5/16		3/8	
Area of 2-8″ Pls.					4.00		5.00		6.00	
6″ 13#	8″	7.64	3	BB	73.68	2.52	84.45	2.58	95.63	2.65
				AA	54.55	2.16	59.89	2.18	65.22	2.19
6″ 10.5#	8″	6.18	3.25	BB	69.28	2.61	80.05	2.68	91.23	2.74
				AA	51.08	2.24	56.41	2.25	61.75	2.25
6″ 8#	8″	4.76	3.5	BB	65.08	2.73	75.85	2.79	87.03	2.84
				AA	47.19	2.32	52.53	2.32	57.86	2.32

TWO COVER PLATES

$\frac{7}{16}$		$\frac{1}{2}$		$\frac{9}{16}$		$\frac{5}{8}$	
10.50		**12.00**		**13.50**		**15.00**	
I	r	I	r	I	r	I	r
259.04	3.73	289.00	3.79	319.80	3.85	351.45	3.90
254.02	3.70	272.02	3.68	290.02	3.67	308.02	3.65
251.64	3.82	281.60	3.88	312.40	3.93	344.05	3.98
239.97	3.74	257.97	3.71	275.97	3.70	293.97	3.68
$\frac{7}{16}$		$\frac{1}{2}$		$\frac{9}{16}$		$\frac{5}{8}$	
8.75		**10.00**		**11.25**		**12.50**	
235.67	3.59	260.63	3.65	286.30	3.71	312.68	3.76
151.75	2.88	162.16	2.88	172.58	2.88	183.00	2.88
227.87	3.68	252.83	3.74	278.50	3.80	304.88	3.85
145.48	2.94	155.89	2.94	166.31	2.93	176.73	2.93
220.47	3.78	245.43	3.83	271.10	3.89	297.48	3.94
138.97	3.00	149.39	2.99	159.80	2.98	170.22	2.98
$\frac{7}{16}$		$\frac{1}{2}$		$\frac{9}{16}$			
8.75		**10.00**		**11.25**			
175.54	3.17	195.23	3.23	215.55	3.29		
149.22	2.93	159.64	2.92	170.05	2.92		
169.54	3.26	189.23	3.32	209.55	3.37		
141.31	2.98	151.73	2.97	162.15	2.96		
163.34	3.36	183.03	3.41	203.35	3.46		
132.19	3.02	142.61	3.01	153.02	3.00		
$\frac{7}{16}$		$\frac{1}{2}$		$\frac{9}{16}$			
7.88		**9.00**		**10.13**			
163.43	3.14	181.15	3.20	199.43	3.26		
106.37	2.53	113.96	2.54	121.56	2.54		
157.43	3.23	175.15	3.29	193.43	3.34		
101.55	2.60	109.14	2.60	116.74	2.60		
151.23	3.34	168.95	3.39	187.23	3.44		
95.78	2.66	103.38	2.65	110.97	2.65		
$\frac{7}{16}$		$\frac{1}{2}$		$\frac{9}{16}$			
8.75		**10.00**		**11.25**			
125.39	2.77	140.43	2.82	156.02	2.87		
144.60	2.97	155.01	2.96	165.43	2.96		
120.99	2.85	136.03	2.90	151.62	2.95		
135.14	3.01	145.56	3.00	155.98	2.99		
116.79	2.94	131.83	2.99	147.42	3.03		
125.12	3.04	135.54	3.03	145.95	3.02		
$\frac{7}{16}$		$\frac{1}{2}$		$\frac{9}{16}$			
7.00		**8.00**		**9.00**			
107.23	2.71	119.27	2.76	131.74	2.81		
70.55	2.20	75.89	2.20	81.22	2.21		
102.83	2.79	114.87	2.85	127.34	2.90		
67.08	2.26	72.41	2.26	77.75	2.26		
98.63	2.90	110.67	2.94	123.14	2.99		
63.20	2.32	68.53	2.32	73.86	2.32		

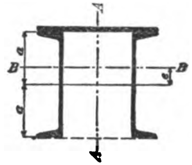


TABLE 24

TWO CHANNELS AND ONE COVER PLATE

Channels. Depth.	Channels. Weight.	Size of Plate.	Total Area of Section.	B. to B. of Channels.	Axis BB. e	Axis BB. I	Axis BB. r	Axis AA. I	Axis AA. r	Size of Plate.	Total Area of Section.	B. to B. of Channels.	Axis BB. e	Axis BB. I	Axis BB. r	Axis AA. I	Axis AA. r
4	5.25	$8\times\frac{1}{4}$	5.10	4.25	.83	13.10	1.60	32.09	2.51								
"	"	$10\times\frac{1}{4}$	5.60	6.25	.95	13.86	1.57	61.40	3.31								
4	6.25	$8\times\frac{1}{4}$	5.68	4	.75	14.26	1.59	33.66	2.43								
"	"	$10\times\frac{1}{4}$	6.18	6	.86	15.13	1.56	65.60	3.26								
5	6.5	$8\times\frac{1}{4}$	5.90	4.25	.89	23.92	2.01	38.27	2.55	$8\times\frac{5}{16}$	6.40	4.25	1.04	25.57	2.00	40.94	2.53
"	"	$10\times\frac{1}{4}$	6.40	6.25	1.03	25.31	1.99	72.73	3.37	$10\times\frac{5}{16}$	7.03	6.25	1.18	27.06	1.95	77.94	3.33
"	"	$12\times\frac{1}{4}$	6.90	8.25	1.14	26.50	1.96	119.99	4.17	$12\times\frac{5}{16}$	7.65	8.25	1.30	28.32	1.92	128.99	4.11
5	9	$8\times\frac{1}{4}$	7.30	4	.72	27.81	1.95	44.57	2.47	$8\times\frac{5}{16}$	7.80	4	.85	29.80	1.95	47.24	2.46
"	"	$10\times\frac{1}{4}$	7.80	6	.84	29.52	1.95	86.34	3.33	$10\times\frac{5}{16}$	8.43	6	.99	31.69	1.94	91.54	3.30
"	"	$12\times\frac{1}{4}$	8.30	8	.95	31.02	1.93	143.70	4.16	$12\times\frac{5}{16}$	9.05	8	1.10	33.32	1.92	152.70	4.11
6	8	$10\times\frac{1}{4}$	7.26	5.5	1.08	42.02	2.41	73.04	3.17	$10\times\frac{5}{16}$	7.89	5.5	1.25	44.82	2.38	78.25	3.15
"	"	$12\times\frac{1}{4}$	7.76	7.5	1.21	43.99	2.38	124.07	4.00	$12\times\frac{5}{16}$	8.51	7.5	1.39	46.92	2.35	133.07	3.95
"	"	$14\times\frac{1}{4}$	8.26	9.5	1.32	45.71	2.35	190.61	4.80	$14\times\frac{5}{16}$	9.14	9.5	1.51	48.74	2.31	204.91	4.74
6	10.5	$10\times\frac{1}{4}$	8.68	5.25	.90	47.60	2.34	83.06	3.09	$10\times\frac{5}{16}$	9.31	5.25	1.06	50.90	2.34	88.27	3.08
"	"	$12\times\frac{1}{4}$	9.18	7.25	1.02	49.94	2.33	143.07	3.95	$12\times\frac{5}{16}$	9.93	7.25	1.19	53.48	2.32	152.07	3.91
"	"	$14\times\frac{1}{4}$	9.68	9.25	1.13	52.04	2.32	221.44	4.78	$14\times\frac{5}{16}$	10.56	9.25	1.31	55.75	2.30	235.73	4.73
7	9.75	$10\times\frac{1}{4}$	8.20	5.25	1.11	65.05	2.82	80.11	3.13	$10\times\frac{5}{16}$	8.83	5.25	1.30	69.20	2.80	85.32	3.11
"	"	$12\times\frac{1}{4}$	8.70	7.25	1.25	68.04	2.80	137.12	3.97	$12\times\frac{5}{16}$	9.45	7.25	1.45	72.46	2.77	146.12	3.93
"	"	$14\times\frac{1}{4}$	9.20	9.25	1.38	70.71	2.77	211.54	4.80	$14\times\frac{5}{16}$	10.08	9.25	1.59	75.32	2.73	225.83	4.73
7	12.25	$10\times\frac{1}{4}$	9.70	5	.93	72.80	2.74	89.23	3.03	$10\times\frac{5}{16}$	10.33	5	1.11	77.55	2.74	94.44	3.02
"	"	$12\times\frac{1}{4}$	10.20	7	1.07	76.24	2.73	155.20	3.90	$12\times\frac{5}{16}$	10.95	7	1.25	81.39	2.73	164.20	3.87
"	"	$14\times\frac{1}{4}$	10.70	9	1.19	79.37	2.72	241.57	4.75	$14\times\frac{5}{16}$	11.58	9	1.38	84.81	2.71	255.86	4.70

TABLE 24 (*Continued*)

TWO CHANNELS AND ONE COVER PLATE

Channels.		Size of Plate.	Total Area of Section.	B. to B. of Channels.	Axis BB.			Axis AA.		Size of Plate.	Total Area of Section.	B. to B. of Channels.	Axis BB.			Axis AA	
Depth.	Weight.				e	I	r	I	r				e	I	r	I	r
8	11.25	12×½	9.70	7	1.28	99.87	3.21	149.97	3.93	12×⅜	11.20	7	1.68	111.87	3.16	167.97	3.87
"	"	14×½	10.20	9	1.42	103.74	3.19	232.46	4.77	14×⅜	11.95	9	1.84	116.29	3.12	261.04	4.67
"	"	16×½	10.70	11	1.54	107.24	3.17	335.34	5.60	16×⅜	12.70	11	1.98	120.19	3.08	378.01	5.46
8	13.75	12×½	11.08	6.75	1.12	109.24	3.14	164.02	3.85	12×⅜	12.58	6.75	1.50	122.75	3.12	182.02	3.80
"	"	14×½	11.58	8.75	1.25	113.57	3.13	256.81	4.71	14×⅜	13.33	8.75	1.65	127.88	3.10	285.39	4.63
"	"	16×½	12.08	10.75	1.37	117.55	3.12	372.76	5.55	16×⅜	14.08	10.75	1.78	132.46	3.07	415.42	5.43
9	13.25	12×½	10.78	6.75	1.29	140.93	3.62	162.90	3.89	12×⅜	12.28	6.75	1.72	157.31	3.58	180.90	3.84
"	"	14×½	11.28	8.75	1.44	146.26	3.60	253.81	4.74	14×⅜	13.03	8.75	1.89	163.55	3.54	282.39	4.66
"	"	16×½	11.78	10.75	1.57	151.13	3.58	367.28	5.58	16×⅜	13.78	10.75	2.04	169.12	3.50	409.94	5.45
9	15	12×½	11.82	6.5	1.17	149.70	3.56	169.96	3.79	12×⅜	13.32	6.5	1.58	167.34	3.54	187.96	3.76
"	"	14×½	12.32	8.5	1.31	155.42	3.55	267.68	4.66	14×⅜	14.07	8.5	1.75	174.19	3.52	296.26	4.59
"	"	16×½	12.82	10.5	1.44	160.69	3.54	390.04	5.52	16×⅜	14.82	10.5	1.90	180.35	3.49	432.71	5.40
10	15	14×½	12.42	8.5	1.44	199.84	4.01	274.97	4.71	14×⅜	14.17	8.5	1.92	222.81	3.97	303.56	4.63
"	"	16×½	12.92	10.5	1.59	206.36	4.00	399.28	5.56	16×⅜	14.92	10.5	2.09	230.42	3.93	441.95	5.44
"	"	18×½	13.42	12.5	1.72	212.38	3.98	549.43	6.40	18×⅜	15.67	12.5	2.24	237.30	3.89	610.18	6.24
10	20	14×½	15.26	8.25	1.18	228.26	3.87	326.42	4.62	14×⅜	17.01	8.25	1.60	255.15	3.87	355.00	4.57
"	"	16×½	15.76	10.25	1.30	235.82	3.87	477.69	5.50	16×⅜	17.76	10.25	1.75	264.40	3.86	520.35	5.41
"	"	18×½	16.26	12.25	1.42	242.91	3.87	660.48	6.37	18×⅜	18.51	12.25	1.89	272.91	3.84	721.23	6.24
10	25	14×½	18.20	8	.99	256.27	3.75	377.73	4.56	14×⅜	19.95	8	1.37	286.18	3.79	406.31	4.51
"	"	16×½	18.70	10	1.10	264.61	3.76	556.42	5.45	16×⅜	20.70	10	1.50	296.75	3.79	599.09	5.38
"	"	18×½	19.20	12	1.20	272.52	3.77	772.52	6.34	18×⅜	21.45	12	1.63	306.59	3.78	833.27	6.23

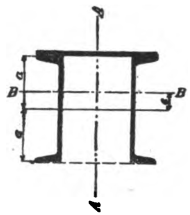
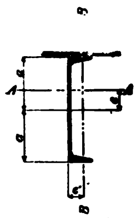


TABLE 24 (*Continued*)

TWO CHANNELS AND ONE COVER PLATE

Channel. Depth.	Channel. Weight.	Size of Plate.	Total Area of Section.	B. to B. of Channels.	Axis BB. e	Axis BB. I	Axis BB. r	Axis AA. I	Axis AA. r	Size of Plate.	Total Area of Section.	B. to B. of Channels.	Axis BB. e	Axis BB. I	Axis BB. r	Axis AA. I	Axis AA. r
12	20.5	16×¼	16.06	9.75	1.53	368.91	4.79	468.52	5.40	16×7/16	19.06	9.75	2.28	427.61	4.74	532.52	5.29
"	"	18×¼	16.56	11.75	1.66	379.17	4.78	651.32	6.27	18×7/16	19.94	11.75	2.46	440.58	4.70	742.44	6.10
"	"	20×¼	17.06	13.75	1.80	388.83	4.77	867.23	7.13	20×7/16	20.81	13.75	2.62	452.46	4.66	992.23	6.91
12	25	16×¼	18.70	9.5	1.31	405.98	4.66	527.50	5.31	16×7/16	21.70	9.5	2.01	471.51	4.66	591.50	5.22
"	"	18×¼	19.20	11.5	1.44	417.28	4.66	737.95	6.20	18×7/16	22.58	11.5	2.17	486.45	4.64	829.80	6.06
"	"	20×¼	19.70	13.5	1.56	428.00	4.66	986.80	7.07	20×7/16	23.45	13.5	2.32	500.28	4.62	1111.80	6.89
12	30	16×¼	21.64	9.25	1.13	445.74	4.54	591.63	5.23	16×7/16	24.64	9.25	1.77	517.33	4.58	655.63	5.16
"	"	18×¼	22.14	11.25	1.25	457.93	4.55	832.50	6.13	18×7/16	25.52	11.25	1.92	534.09	4.58	923.62	6.02
"	"	20×¼	22.64	13.25	1.35	469.58	4.55	1117.64	7.03	20×7/16	26.39	13.25	2.06	549.75	4.56	1242.64	6.86
15	33	18×⅜	26.55	11.25	1.96	922.81	5.90	1014.54	6.18	18×½	28.80	11.25	2.42	997.02	5.88	1075.29	6.11
"	"	20×⅜	27.30	13.25	2.11	946.75	5.89	1356.28	7.05	20×½	29.80	13.25	2.60	1024.48	5.86	1439.62	6.95
"	"	22×⅜	28.05	15.25	2.26	969.50	5.88	1752.63	7.90	22×½	30.80	15.25	2.77	1050.16	5.84	1863.54	7.78
15	35	18×⅜	27.33	11.25	1.90	940.50	5.87	1045.86	6.19	18×½	29.58	11.25	2.36	1016.28	5.86	1106.61	6.12
"	"	20×⅜	28.08	13.25	2.05	964.98	5.86	1398.19	7.06	20×½	30.58	13.25	2.53	1044.42	5.84	1481.52	6.96
"	"	22×⅜	28.83	15.25	2.20	988.18	5.85	1806.68	7.92	22×½	31.58	15.25	2.70	1070.78	5.82	1917.60	7.79
15	40	18×⅜	30.27	11	1.71	1005.07	5.76	1129.51	6.11	18×½	32.52	11	2.15	1086.15	5.78	1190.26	6.05
"	"	20×⅜	31.02	13	1.86	1031.20	5.77	1516.33	6.99	20×½	33.52	13	2.31	1116.65	5.77	1599.66	6.91
"	"	22×⅜	31.77	15	2.00	1056.09	5.77	1965.19	7.86	22×½	34.52	15	2.47	1145.38	5.76	2076.11	7.76
15	45	18×⅜	33.23	10.75	1.56	1068.20	5.67	1208.61	6.03	18×½	35.48	10.75	1.97	1153.83	5.70	1269.36	5.98
"	"	20×⅜	33.98	12.75	1.70	1095.73	5.68	1629.23	6.92	20×½	36.48	12.75	2.12	1186.39	5.70	1712.56	6.85
"	"	22×⅜	34.73	14.75	1.83	1122.08	5.68	2117.81	7.81	22×½	37.48	14.75	2.28	1217.21	5.70	2228.73	7.71

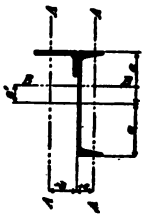


ONE CHANNEL AND ONE PLATE

G EQUALS GAUGE OF CHANNEL

Channel. Depth.	Channel. Weight.	Size of Plate.	Area of Section.	Axis AA. e	Axis AA. I	Axis AA. r	Axis BB. e′	Axis BB. I	Axis BB. r	G
9	13.25	8× ⅜	6.89	2.04	84.55	3.50	.94	18.77	1.65	1⅜
"	"	8× 5/16	6.39	1.82	80.31	3.55	.91	16.00	1.58	
"	"	8× ¼	5.89	1.57	75.56	3.58	.87	13.22	1.50	"
8	11.25	8× ⅜	6.35	1.98	60.08	3.08	.89	18.05	1.69	1¼
"	"	8× 5/16	5.85	1.78	57.05	3.12	.86	15.31	1.62	"
"	"	8× ¼	5.35	1.54	53.62	3.17	.83	12.57	1.53	"
7	9.75	8× 5/16	5.35	1.71	38.92	2.70	.88	14.97	1.67	1¼
"	"	8× ¼	4.85	1.49	36.55	2.74	.84	12.23	1.59	"
"	"	7× 5/16	5.04	1.59	37.66	2.73	.85	10.52	1.45	"
"	"	7× ¼	4.60	1.38	35.36	2.77	.81	8.67	1.37	"
6	8	7× 5/16	4.57	1.51	24.37	2.31	.81	10.05	1.48	1⅛
"	"	7× ¼	4.13	1.32	22.86	2.35	.77	8.22	1.41	"
"	"	6× ¼	3.88	1.21	21.99	2.38	.75	5.54	1.19	"

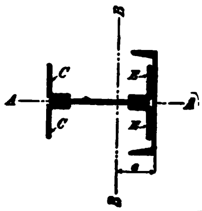
TABLE 26



ONE CHANNEL AND ONE ANGLE

LONG LEG OF ANGLE PERPENDICULAR TO WEB OF CHANNEL
BACK OF ANGLE FLUSH WITH FLANGE OF CHANNEL

Channel.		Size of Angle.	Total Area.	Axis BB.			Axis AA.		
Depth.	Weight.			e′	I	r	e	I	r
12	20.5	$5\times3\frac{1}{2}\times\frac{5}{16}$	8.59	1.54	178.67	4.56	+.02	19.97	1.52
"	"	$4\times3\times\frac{5}{16}$	8.12	1.35	172.37	4.61	+.20	13.28	1.28
10	15	$5\times3\frac{1}{2}\times\frac{5}{16}$	7.02	1.52	97.77	3.73	−.17	16.98	1.56
"	"	$4\times3\times\frac{5}{16}$	6.55	1.35	94.13	3.79	+.03	10.81	1.28
9	13.25	$5\times3\frac{1}{2}\times\frac{5}{16}$	6.45	1.45	70.70	3.31	−.26	15.82	1.57
"	"	$4\times3\times\frac{5}{16}$	5.98	1.31	67.97	3.37	−.05	9.89	1.29
8	11.25	$4\times3\times\frac{5}{16}$	5.44	1.24	47.46	2.95	−.13	9.05	1.29
"	"	$3\times2\frac{1}{2}\times\frac{1}{4}$	4.66	.94	43.55	3.06	+.16	4.58	.99
7	9.75	$4\times3\times\frac{5}{16}$	4.94	1.16	31.80	2.54	−.22	8.29	1.30
"	"	$3\times2\frac{1}{2}\times\frac{1}{4}$	4.16	.89	29.08	2.64	+.09	4.05	.99
6	8	$4\times3\times\frac{5}{16}$	4.47	1.05	20.23	2.13	−.31	7.59	1.30
"	"	$3\times2\frac{1}{2}\times\frac{1}{4}$	3.69	.83	18.37	2.23	+.01	3.59	.99



FOUR ANGLES, ONE PLATE, AND ONE CHANNEL

Back to back of Angles = width of Plate + ½″
L indicates long leg of Angles "E" in contact with channel
S indicates short leg of Angles "E" in contact with channel

Size of Plate.	Size of Angles "C."	Size of Angles "E."	Channel.		Total Area.	Axis AA.		Axis BB.			Angles "E."
			Depth.	Weight.		I	r	I	r	e	
36×⅝	6×6 ×⅝	6×6 ×⅝	15	33	60.84	528.62	2.95	12785.41	14.50	15.64	
36×½	6×6 ×½	6×6 ×½	15	33	50.90	478.29	3.07	10759.02	14.54	15.08	
36×⅜	6×6 ×⅜	6×6 ×⅜	15	33	40.84	432.56	3.25	8625.16	14.53	14.23	
30×⅝	6×6 ×⅝	6×6 ×⅝	15	33	57.09	528.50	3.04	8389.78	12.12	12.97	
30×½	6×6 ×½	6×6 ×½	15	33	47.90	478.22	3.16	7074.84	12.15	12.48	
30×⅜	6×6 ×⅜	6×6 ×⅜	15	33	38.59	432.54	3.35	5682.11	12.14	11.75	
30×⅝	6×4 ×⅝	6×4 ×⅝	15	33	52.09	526.11	3.18	7841.38	12.27	12.73	L
30×½	6×4 ×½	6×4 ×½	15	33	43.90	477.85	3.30	6618.33	12.28	12.20	L
30×⅜	6×4 ×⅜	6×4 ×⅜	15	33	35.59	431.97	3.48	5327.84	12.23	11.43	L
24×½	6×4 ×½	6×4 ×½	15	33	40.90	477.78	3.42	3997.71	9.89	9.69	L
24×⅜	6×4 ×⅜	6×4 ×⅜	15	33	33.34	431.94	3.60	3224.18	9.83	9.04	L
24×½	5×3½×½	5×3½×½	12	20.5	34.03	196.38	2.40	3193.45	9.69	10.51	S
24×⅜	5×3½×⅜	5×3½×⅜	12	20.5	27.23	176.53	2.55	2572.07	9.72	9.98	S
24×½	6×4 ×½	4×3 ×½	12	20.5	34.03	237.14	2.64	3387.15	9.98	11.28	L
24×⅜	6×4 ×⅜	4×3 ×⅜	12	20.5	27.21	206.43	2.75	2738.78	10.03	10.71	L
21×½	6×4 ×½	6×4 ×½	15	33	39.40	477.75	3.48	2958.90	8.67	8.46	L
21×⅜	6×4 ×⅜	6×4 ×⅜	15	33	32.22	431.93	3.66	2389.51	8.61	7.88	L
21×½	5×3½×½	5×3½×½	12	20.5	32.53	196.35	2.46	2348.64	8.50	9.20	S
21×⅜	5×3½×⅜	5×3½×⅜	12	20.5	26.11	176.51	2.60	1895.95	8.52	8.72	S
21×½	6×4 ×½	4×3 ×½	12	20.5	32.53	237.11	2.70	2505.38	8.78	9.87	L
21×⅜	6×4 ×⅜	4×3 ×⅜	12	20.5	26.09	206.41	2.81	2029.79	8.82	9.36	L
18×½	6×4 ×½	6×4 ×½	15	33	37.90	477.72	3.55	2091.22	7.43	7.25	L
18×⅜	6×4 ×⅜	6×4 ×⅜	15	33	31.09	431.92	3.73	1691.84	7.38	6.75	L
18×½	6×4 ×½	4×3 ×½	10	15	29.46	161.98	2.34	1626.05	7.43	8.95	S
18×⅜	6×4 ×⅜	4×3 ×⅜	10	15	23.39	135.08	2.40	1315.82	7.50	8.57	S
15×½	6×4 ×½	4×3 ×½	10	15	27.96	161.94	2.41	1070.58	6.19	7.50	S
15×⅜	6×4 ×⅜	4×3 ×⅜	10	15	22.27	135.07	2.46	870.01	6.25	7.17	S

SECTIONS OF COLUMNS, SECTIONS OF TOP CHORDS,

Selected from some of the Largest Buildings and Bridges in the United States

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The values of the sections covered by the tables on Moments of Inertia and Radii of Gyration are suitable for structures of ordinary proportions. The variety of ways in which standard shapes are used to compose sections of monumental structures, has made it necessary to treat this class separately. The sections here given are selected from some of the largest buildings and bridges in the United States. The types show what is customary as well as what can be done when circumstances and conditions demand it. It is necessary to be acquainted with these conditions in order to compare intelligently the values of these sections. They are classified and tabulated here in order to more readily serve as a guide in the design of new structures.

TABLE 28

PROPERTIES OF COLUMNS

SECTIONS OF WHICH ARE SHOWN ON PAGES 56 TO 60

Name of Building.	Area.	Weight.	Axis AA.		Axis BB.	
			I	r	I	r
Columns having One Web Plate.						
First National Bank Building, Chicago	159.11	541.0	11470	8.49	3140	4.44
Frick Building, Pittsburg	172.61	586.9	13180	8.74	3510	4.51
Column 43 C. & N. W. R'y Office Building, Chicago	134.51	457.3	6120	6.74	2080	3.93
Column 24 C. & N. W. R'y Office Building, Chicago	175.50	596.7	9160	7.23	3850	4.69
Land Title Building, Philadelphia	198.98	676.5	15580	8.85	4040	4.50
Columns having Two Web Plates.						
Rock Island R'y Station, Chicago	57.74	196.3	1660	5.36	1120	4.40
Park Row Building, New York	195.76	665.6	14460	8.60	11340	7.61
Column (*a*), Ivins Building, New York	228.76	777.8	26010	10.66	10890	6.90
Wanamaker Building, New York	352.14	1197.3	35440	10.03	18780	7.30
Adams Building, Chicago	174.00	591.6	8220	6.87	3670	4.60
Columns having Three Web Plates.						
Farmers' Bank Building, Pittsburg	233.42	793.6	9400	6.33	9950	6.53
Column 1 Waldorf-Astoria Hotel, New York	180.10	612.3	8900	7.03	5320	5.43
Column (*b*) Ivins Building, New York	188.74	641.7	21940	10.78	10270	7.38
Miscellaneous Types.						
Column 280 Waldorf-Astoria Hotel, New York	381.17	1296.0	63380	12.89	35930	9.71
Column (*a*) Illinois Steel Co., Chicago	114.58	389.6	24070	14.50	8360	8.54
Column (*b*) Illinois Steel Co., Chicago	202.91	689.9	87040	20.71	18190	9.47

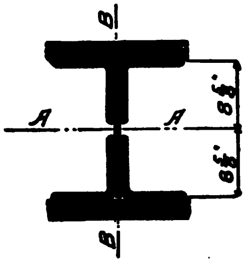
TABLE 29

PROPERTIES OF TOP CHORDS OF BRIDGES

SECTIONS OF WHICH ARE SHOWN ON PAGES 61 TO 66

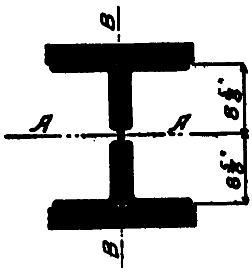
Name of Bridge or Structure.	Area.	Weight.	Axis AA.		Axis BB.	
			I	r	I	r
Laced Top and Bottom, Two Webs.						
Williamsburg Bridge, New York	143.98	489.5	14370	9.99	11440	8.91
300 Foot Span, Boone Viaduct, Boone, Ia.	121.00	411.4	12660	10.23	14500	10.95
Panther Hollow Steel Arch, Pittsburg	108.05	367.4	11340	10.25	9660	9.45
International Bridge, Buffalo	190.34	647.1	29730	12.50	23760	11.17
Monongahela Bridge, Pittsburg	347.50	1181.5	43790	11.22	165620	21.83
Laced Top and Bottom, Three Webs.						
Niagara Cantilever Bridge, Niagara Falls	230.73	784.5	11890	7.18	50130	14.74
Laced Top and Bottom, Four Webs.						
Memphis Bridge, Memphis, Tenn.	250.52	851.8	52460	14.47	24270	9.84
Thebes Bridge, Thebes, Ill.	282.02	958.9	50760	13.42	114930	20.19
Cover Plate on Top, Two Webs.						
New Omaha Bridge, Omaha, Nebraska.	85.26	289.9	4190	7.01	8920	10.23
Cairo Bridge, Cairo, Kentucky	138.26	470.1	9810	8.42	20750	12.25
International Bridge, Buffalo	110.38	375.3	9550	9.30	10900	9.93
Cover Plate on Top, Four Webs.						
Sixth Street Bridge, Pittsburg	182.42	620.5	24000	11.47	22100	11.01
Bellefontaine Bridge, Alton, Ill.	211.10	718.0	39880	13.80	16720	8.90
Monongahela River Bridge, Pittsburg	273.05	928.4	32480	10.90	61090	14.96
Rankin Bridge, Rankin, Pa.	334.52	1137.4	44960	11.59	68740	14.33
Miscellaneous Types.						
(Roof Truss) Waldorf-Astoria Hotel, New York	314.25	1068.4	34270	10.44	27990	9.43
Eads Bridge, St. Louis	116.60	396.4	3640	5.59	3640	5.59

SECTIONS OF COLUMNS



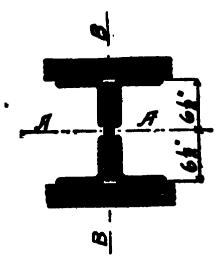
FIRST NATIONAL BANK BUILDING, CHICAGO

4 ∟s – 8″ × 8″ × $\frac{15}{16}$″
1 Pl. – 17″ × $\frac{7}{8}$″
6 Pls. – 18″ × $\frac{13}{16}$″



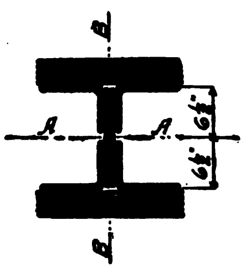
FRICK BUILDING, PITTSBURG

4 ∟s – 8″ × 8″ × $\frac{15}{16}$″
6 Pls. – 18″ × $\frac{15}{16}$″
1 Pl. – 17″ × $\frac{7}{8}$″



COLUMN 43, C. & N. W. R'Y OFFICE BUILDING, CHICAGO

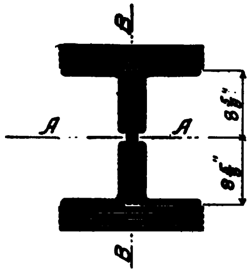
6 Pls. – 16″ × $\frac{5}{8}$″
2 Pls. – 16″ × $\frac{11}{16}$″
2 Pls. – 12$\frac{1}{2}$″ × $\frac{3}{4}$″
4 ∟s – 6″ × 6″ × $\frac{3}{4}$″



COLUMN 24, C. & N. W. R'Y OFFICE BUILDING, CHICAGO

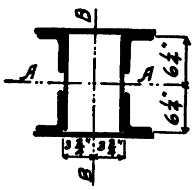
6 Pls. – 18″ × $\frac{5}{8}$″
4 Pls. – 18″ × $\frac{11}{16}$″
2 Pls. – 12$\frac{1}{2}$″ × $\frac{3}{4}$″
4 ∟s – 8″ × 6″ × $\frac{3}{4}$″

SECTIONS OF COLUMNS



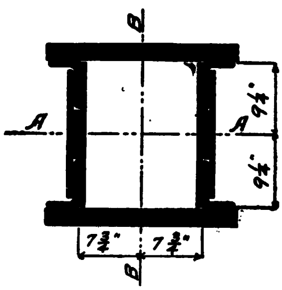
LAND TITLE BUILDING, PHILADELPHIA

4 Ls — 8″ × 8″ × $\frac{15}{16}$″
2 Pls. — 17″ × $\frac{3}{4}$″
8 Pls. — 18″ × $\frac{13}{16}$″



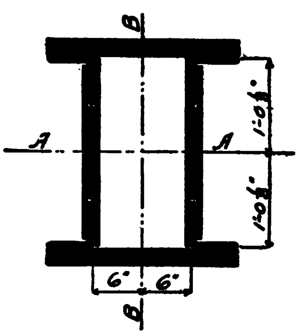
ROCK ISLAND RAILWAY STATION, CHICAGO

4 Ls — 5″ × 3½″ × $\frac{3}{4}$″
2 Pls. — 12″ × ½″
2 Pls. — 15″ × $\frac{3}{4}$″



PARK ROW BUILDING, NEW YORK

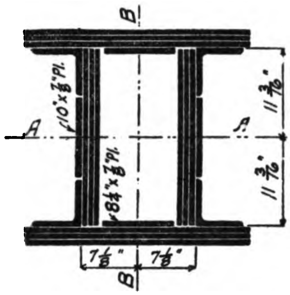
6 Pls. — 24″ × $\frac{3}{4}$″
4 Ls — 6″ × 4″ × $\frac{3}{4}$″
2 Pls. — 16″ × $\frac{3}{4}$″
2 Pls. — 6″ × $\frac{3}{4}$″
2 Pls. — 18″ × $\frac{3}{4}$″



COLUMN (a), IVINS BUILDING, NEW YORK

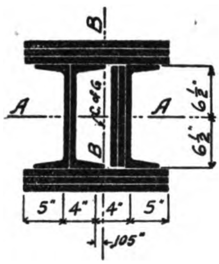
4 Ls — 6″ × 6″ × $\frac{3}{4}$″
2 Web Pls. — 24″ × $\frac{3}{4}$″
2 Side Pls. — 22″ × $\frac{3}{4}$″
2 Side Pls. — 12″ × $\frac{3}{4}$″
6 Cover Pls. — 24″ × $\frac{3}{4}$″

SECTIONS OF COLUMNS



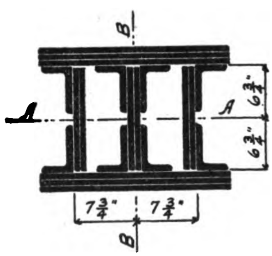
WANAMAKER BUILDING, NEW YORK

4 ∟s – 6″ × 6″ × 7/8″
6 Pls. – 28″ × 15/16″
6 Pls. – 22″ × 15/16″
2 Pls. – 10″ × 7/8″
2 Pls. – 8 1/4″ × 7/8″



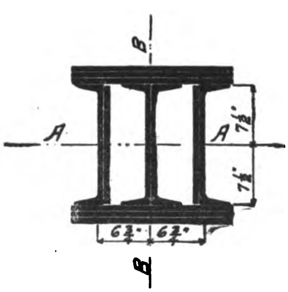
ADAMS BUILDING, CHICAGO

3 – 13″ [s 50#
6 Pls. – 18″ × 1″
2 Pls. – 12 1/2″ × 7/8″



FARMERS' BANK BUILDING, PITTSBURG

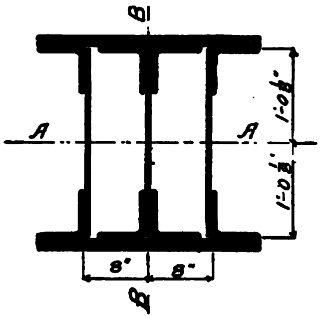
6 Pls. – 13″ × 3/4″
8 ∟s – 6″ × 4″ × 7/8″
2 Pls. – 24″ × 13/16″
4 Pls. – 24″ × 3/4″



COLUMN 1, WALDORF-ASTORIA HOTEL, NEW YORK

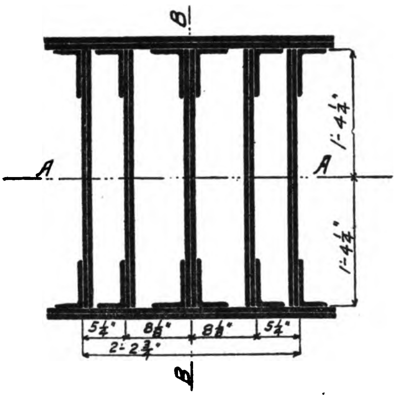
4 – 15″ [s 55#
2 Pls. – 14 1/2″ × 7/8″
6 Pls. – 20″ × 3/4″

SECTIONS OF COLUMNS



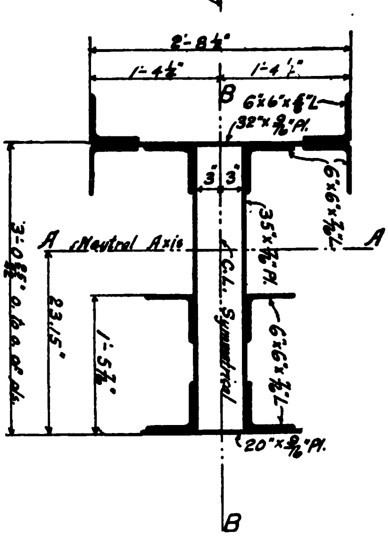
COLUMN (b), IVINS BUILDING, NEW YORK

3 Web Pls. — 24″ × 11/16″
4 Cover Pls. — 28″ × 11/16″
8 ∟s — 6″ × 6″ × 11/16″

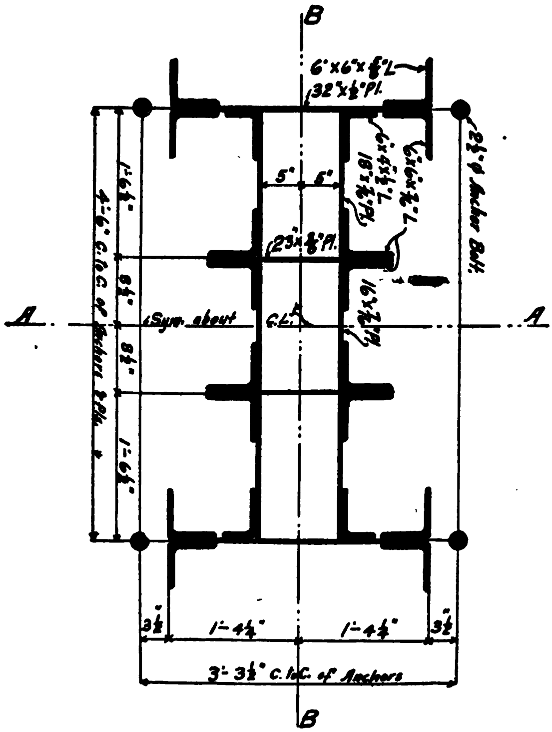


COLUMN 280, WALDORF-ASTORIA HOTEL, NEW YORK

10 Pls. — 32½″ × 5/8″
4 Pls. — 36″ × 3/4″
4 ∟s — 6″ × 4″ × 11/16″
8 ∟s — 6″ × 3½″ × 5/8″

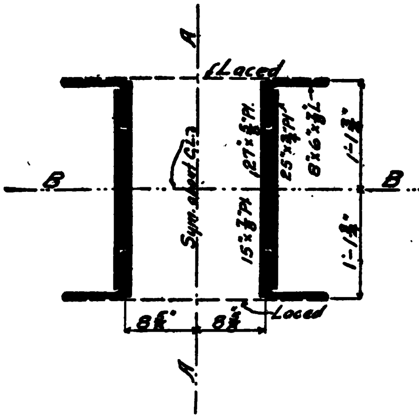


COLUMN (a), ILLINOIS STEEL COMPANY, CHICAGO

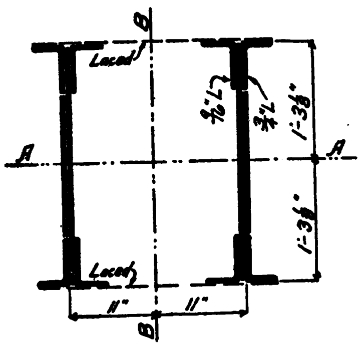


COLUMN (b), ILLINOIS STEEL CO., CHICAGO

SECTIONS OF BRIDGE CHORDS

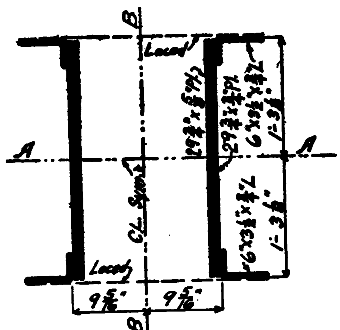


WILLIAMSBURG BRIDGE, NEW YORK

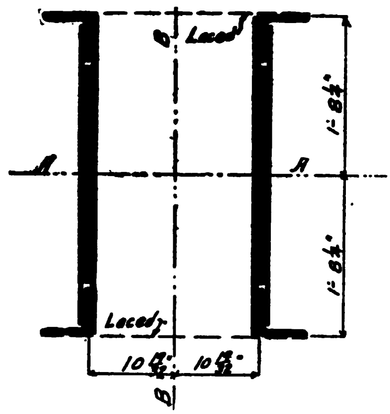


300-FOOT SPAN, BOONE VIADUCT, BOONE, IOWA

4 ∟s – 6″ × 4″ × $\frac{3}{4}$″
4 ∟s – 6″ × 4″ × $\frac{9}{16}$″
2 Pls. – 30″ × $\frac{3}{4}$″
2 Pls. – 18″ × $\frac{3}{4}$″

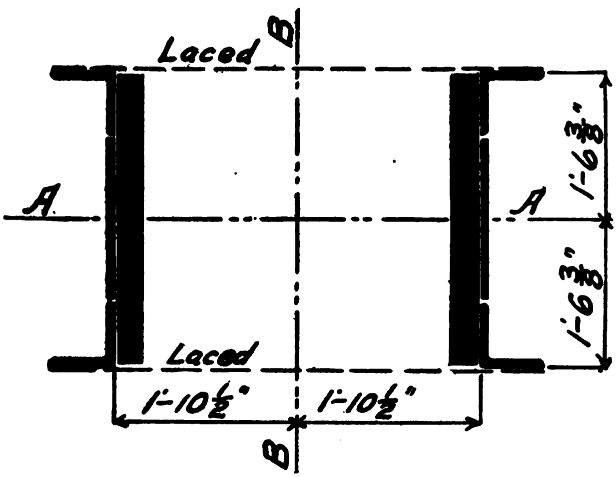


PANTHER HOLLOW STEEL ARCH, PITTSBURG



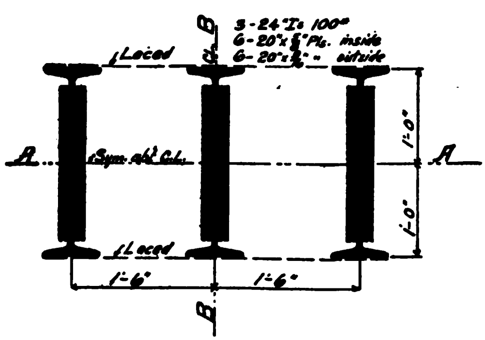
INTERNATIONAL BRIDGE, BUFFALO

4 Ls — 6″ × 6″ × $\frac{7}{8}$″
2 Pls. — 40″ × $\frac{7}{8}$″
2 Pls. — 27½″ × $\frac{7}{8}$″
2 Pls. — 38″ × $\frac{7}{16}$″



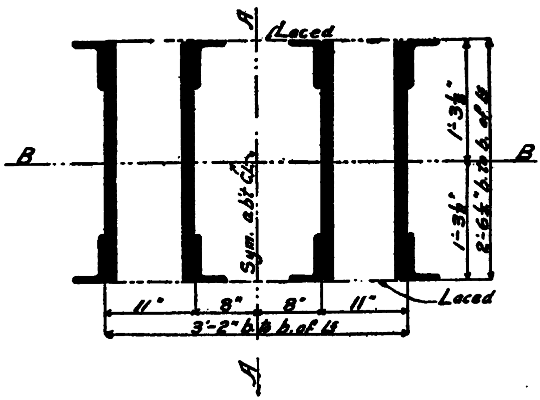
MONONGAHELA BRIDGE, PITTSBURG

4 Ls — 8″ × 8″ × 1″
2 Pls. — 20″ × 1″
2 Pls. — 36″ × $3\frac{7}{16}$″



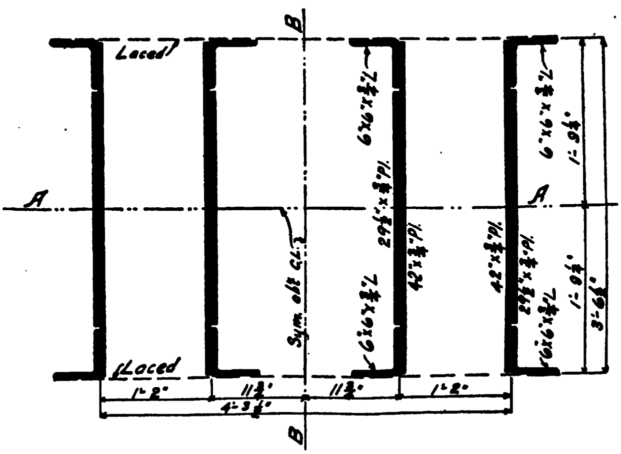
NIAGARA CANTILEVER BRIDGE, NIAGARA FALLS

SECTIONS OF BRIDGE CHORDS

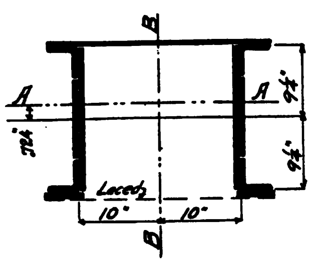


MEMPHIS BRIDGE,
MEMPHIS, TENN.

8 Ls — 6″ × 4″ × ¾″
8 Pls. — 30″ × 1 3/16″



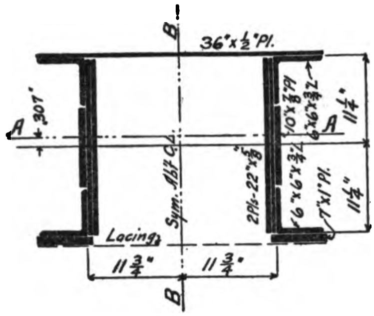
THEBES BRIDGE,
THEBES, ILL.



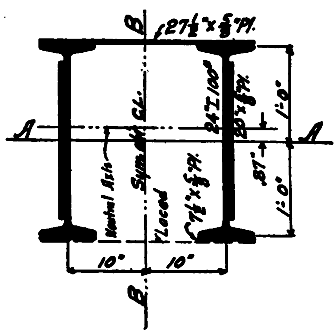
NEW OMAHA BRIDGE,
OMAHA, NEB.

4 Ls — 4″ × 4″ × ¾″
1 Pl. — 28″ × ½″
2 Pls. — 18″ × ¾″
2 Pls. — 10″ × ¾″
2 Pls. — 5″ × ¾″

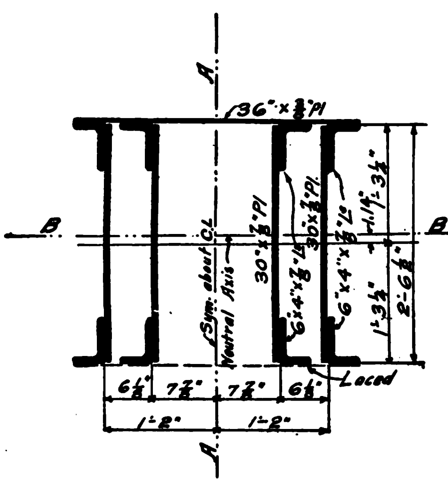
SECTIONS OF BRIDGE CHORDS



CAIRO BRIDGE,
CAIRO, KENTUCKY

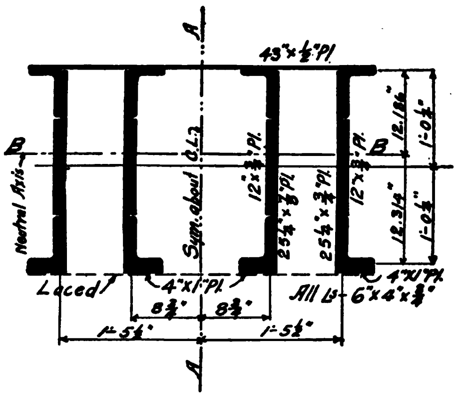


INTERNATIONAL BRIDGE,
BUFFALO

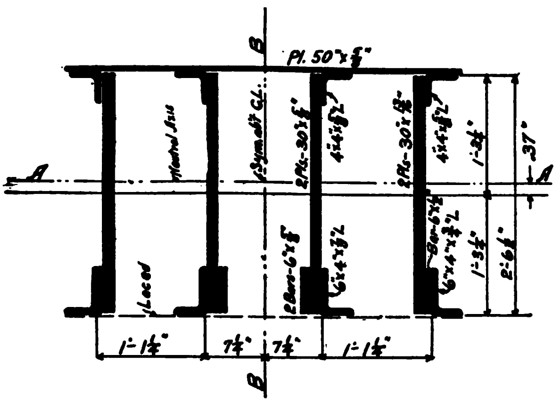


SIXTH STREET BRIDGE,
PITTSBURG

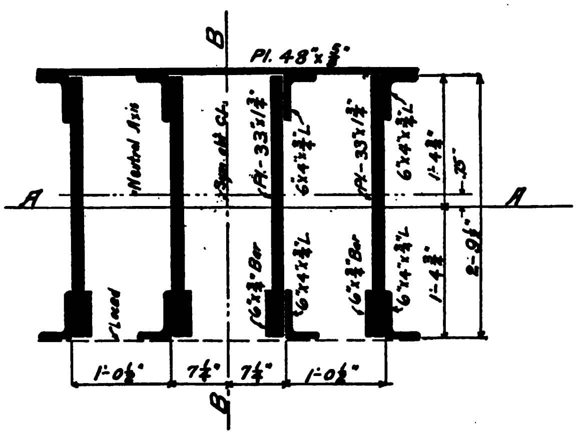
SECTIONS OF BRIDGE CHORDS



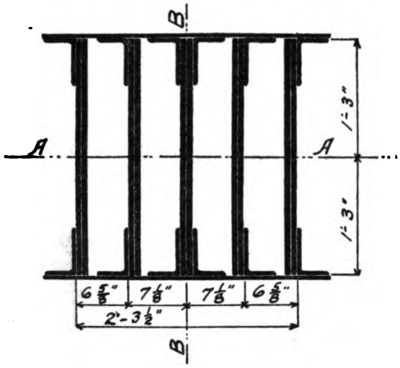
BELLEFONTAINE BRIDGE, ALTON, ILLINOIS



MONONGAHELA RIVER BRIDGE, PITTSBURG

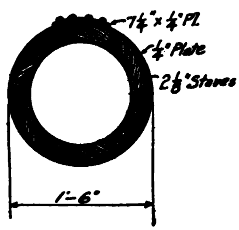


RANKIN BRIDGE, RANKIN, PA.



ROOF TRUSS, WALDORF-ASTORIA HOTEL, NEW YORK

12 Ls — 6" × 4" × ½"
10 Pls. — 29½" × ¾"
2 Pls. — 36" × ½"



EADS BRIDGE, ST. LOUIS

UNIT STRAINS

The following data on unit strains, pages 67, 68, 69, 70, 71, and 73, is taken from Bulletin No. 41 of the American Railway Engineering and Maintenance of Way Association, published in 1903.

STRAINS UNDER DYNAMIC LOADS

The subject of unit strains in iron and steel structures is, as said before, so closely related to the quality and strength of material used, and the loading which the structure has to carry, that the three must be studied together.

The quality and strength of material to be used in the structure is well known from the numerous tests made on both specimens and full-sized structural members in the last fifty years, during which period iron and steel have been used for structures of various kinds.

The load which the structure may have to carry during its service is, on the contrary, more or less an assumption at the time the structure is designed.

If this is a railroad bridge, we assume that it shall carry a load represented by a typical train. The static load applied on the bridge from this typical train may closely represent the static load of the heaviest actual train passing over the bridge when in service, but we are still in doubt how much this static load should be increased to closely represent the dynamic load from the moving train.

It is on the question how to provide for this dynamic load of the moving train that the engineers who design bridges differ, and there is a wide field for the investigator to determine by experiments and observation what the relations are between the static train load and the load produced by the moving train for various lengths of spans and for the various members of the bridge. Such investigation, if carefully made and of sufficient extent, would be of great value to both the designers and the purchasers of bridges. The Committee is now making some investigations in this direction in connection with the subject of impact.

Two distinct methods are used to provide for the excess of the dynamic load above the assumed static load. The first method, which we may say has been used ever since bridge designing became a science, and which is still adhered to by many engineers, is to vary the unit strains in the different members of the structure according to some rule. Some engineers vary the unit strains according to the relation between live and dead load, or total load and dead load; some use different fixed unit strain for the different members of the structure; and some use different unit strains for live load and for dead load.

The second method, which has lately found favor with and has been adopted by many of the American engineers, is to use a constant unit strain for the same grade of material and provide for the dynamic effect of the load by increasing the static live-load strains according to impact formulas.

This last method seems to be the most rational, as it treats the dynamic increment of the load as a load, and not as a decreased strength of material.

It has been thoroughly demonstrated, by experiments, that when a piece of iron or steel is strained above its elastic limit, but below its ultimate strength, it will finally break if the strain is repeated a sufficient number of times, and that the nearer this strain is kept to the elastic limit, the larger is the number of repetitions of the strain that are required to break the piece, and that when this repeated strain is close above the elastic limit, the number of repetitions required to break the piece rapidly approaches infinity. It is therefore reasonable to assume that a piece strained below the elastic limit will stand any number of repetitions of the strain without being injured or reduced in strength.

If, therefore, all the possible strains with their dynamic increment to which the various members of the structure will probably be subjected are found, and if such perfect workmanship is possible that each piece in a member is strained equally per unit with every other piece in the same member, and the material is free from defects, then it would be safe to use a unit strain equal to that required to strain the member up to the elastic limit. The material may have defects not discovered by the inspection and the workmanship is not perfect. The pieces forming the member will, therefore, not be equally strained in the finished structure. Some pieces may have to be stretched considerably before other pieces take any of the strain.

How much additional section should be allowed for these defects in material and workmanship depends on the care taken in the manufacturing at mills and shops, and on the thoroughness of inspection. If the section is increased seventy-five per cent., it seems reasonable to assume that these defects have been provided for very liberally. This would give an allowable unit strain equal to four-sevenths of the elastic limit.

UNIT STRAINS IN COMPRESSION MEMBERS

There is much diversity of opinion in regard to unit strains for compression members. Numerous tests have been made, the results plotted on diagrams, and formulas devised to agree as closely as possible with the average of the results of tests. Most of these formulas, when reduced to the same base unit, follow each other closely within the limits for length of member divided by least radius of gyration of cross-section of member that are used in good designing.

The attached diagram (page 73) gives the allowed unit strains, derived from some well-known formulas for the various relations of "l over r," reduced to a base unit strain of 16,000 pounds per square inch.

The straight-line formula, first proposed by Thomas H. Johnson, and used, among others, by Theodore Cooper in his specifications, is very simple, and gives values that are no doubt as close to the actual conditions as any of the other more complicated formulas, within the limits for the relation "l over r" used in good designing.

This formula discourages inexperienced designers from using long and flimsy compression members, which they are very apt to do when they use a formula which will allow comparatively high unit strains for high values of the relation "l over r."

The earlier formulas always made a distinction between members with pin end connections and members with riveted end connections, but the later formulas make no such distinction.

A member with pin end connections is not as rigid as a member with riveted end connections; but, on the contrary, pin connections do not transmit the secondary bending strains, caused by the deflection of the structure, to their member as much as riveted connections. It seems, therefore, as if the advantage of stiffness in a member with riveted end connections is, at least to some extent, counterbalanced by the disadvantage of transmitted bending strains, and that there is practically no difference in strength between the two members, if of same section but with the above difference in end connection.

Our knowledge is still limited in regard to the effects of alternating and combined strains. As the members subject to these strains are very few in an ordinary structure, we can afford to be liberal with material in proportioning them.

The large number of bridges are of so short spans that the lateral and sway bracing should be proportioned to resist the effect of the swinging and swaying of the trains rather than the effect of the wind pressure. The term "wind bracing" is misleading, except for long spans. There is no reason why the unit strains allowed on these parts of the structure should be different from those previously given.

SUMMARY OF COMPRESSION FORMULÆ

From Bulletin No. 41 of the American Railway Engineering and Maintenance of Way Association

A — Gordon's Formula.
Square bearing.

$$sP_1 = \frac{50000}{1 + \frac{l^2}{36000\ r^2}}$$

B — Gordon's Formula.
Pin and square bearing.

$$sP_1 = \frac{50000}{1 + \frac{l^2}{24000\ r^2}}$$

C — Gordon's Formula.
Pin bearing.

$$sP_1 = \frac{50000}{1 + \frac{l^2}{18000\ r^2}}$$

D — American Bridge Co.
Standard specifications railway bridges.

$$P_1 = \frac{15000}{1 + \frac{l^2}{13500\ r^2}}$$

E — Boston & Maine R. R.
Standard specifications riveted members.

$$_1 = \frac{a}{10000} \times \frac{8700}{1 + \frac{l^2}{28000\ r^2}}$$

F — Boston & Maine R. R.
Standard specifications pin members.

$$P_1 = \frac{a}{10000} \times \frac{8700}{1 + \frac{l^2}{14000\ r^2}}$$

G — J. B. Johnson's Formula.
Riveted ends.

$$P_1 = \frac{1}{2}\left(\frac{f}{2 + \frac{f - P_1}{25\ E}\left(\frac{l}{r}\right)^2}\right)$$

H — J. B. Johnson's Formula.
Pin ends.

$$P_1 = \frac{1}{2}\left(\frac{f}{2 + \frac{f - P_1}{16\ E}\left(\frac{l}{r}\right)^2}\right)$$

SUMMARY OF COMPRESSION FORMULÆ (*Continued*)

From Bulletin No. 41 of the American Railway Engineering and Maintenance of Way Association

I — Max von Leber's Formula.
In Bulletin of European Railway Congress.

$$P_1 = \frac{P}{1 + 0.01 \frac{l}{r}}$$

J — Cooper's Formula.
Chord segments. Live load strains.

$$P_1 = 10000 - 45 \frac{l}{r}$$

K — Cooper's Formula.
Posts of through bridges. Live load strains.

$$P_1 = 8500 - 45 \frac{l}{r}$$

L — Cooper's Formula.
Posts of deck bridges. Live load strains.

$$P_1 = 9000 - 40 \frac{l}{r}$$

M — Formula recommended by the
Committee on Iron and Steel Structures.

$$P_1 = 16000 - 70 \frac{l}{r}$$

P = Base unit strains in lbs. per square inch.
P_1 = Allowable unit strains in lbs. per square inch.
l = Unsupported length in inches.
r = Least radius of gyration in inches.
E = Modulus of elasticity = 29,000,000.
f = Elastic limit = 28,000.
a = Values given in table in Boston & Maine R. R. specifications for metal bridges, 1896.
s = Factor of safety.

TABLE 30

VALUES DERIVED FROM FORMULÆ ON PAGES 70 AND 71

REDUCED TO 16,000 BASE UNIT, AND CORRESPONDING TO CURVES ON SHEET NO. 2

$\frac{l}{r}$	A	B	C	D	E	F	G	H	I	J	K	L	M
0	16000	16000	16000	16000	13920	13920	16000	16000	16000	16000	16000	16000	16000
10	15960	15930	15910	15880	13870	13820	15980	15960	14550	15280	15150	15290	15300
20	15820	15740	15650	15540	13720	13530	15910	15860	13330	14560	14310	14580	14600
30	15610	15420	15240	15000	13490	13080	15790	15680	12310	13840	13460	13870	13900
40	15320	15000	14690	14300	13170	12490	15630	15440	11430	13120	12610	13160	13200
50	14960	14490	14050	13500	12780	11810	15430	15130	10670	12400	11770	12440	12500
60	14550	13910	13330	12630	12330	11070	15190	14770	10000	11680	10920	11730	11800
70	14080	13290	12580	11740	11850	10310	14920	14350	9410	10960	10070	11020	11100
80	13590	12630	11800	10850	11330	9550	14610	13900	8890	10240	9220	10310	10400
90	13060	11960	11030	10000	10800	8820	14270	13410	8420	9520	8380	9600	9700
100	12520	11290	10280	9190	10260	8120	13900	12890	8000	8800	7530	8890	9000
110	11980	10640	9570	8440	9720	7470	13510	12360	7620	8080	6680	8180	8300
120	11430	10000	8890	7740	9190	6860	13100	11810	7270	7360	5840	7870	7600
130	10890	9390	8250	7110	8680	6310	12680	11270	6960	6640	4990	6760	6900
140	10360	8810	7660	6530	8190	5800	12250	10720	6670	5920	4140	6040	6200
150	9850	8260	7110	6000	7720	5340	11810	10190	6400	5200	3300	5330	5500
160	9350	7740	6610	5520	7270	4920	11380	9660	6150	4480	2450	4620	4800
170	8880	7260	6140	5090	6850	4540	10940	9160	5930	3760	1600	3910	4100
180	8420	6810	5710	4710	6450	4200	10500	8670	5710	3040	750	3200	3400
190	7990	6390	5320	4360	6080	3890	10080	8210	5520	2320	−90	2490	2700
200	7580	6000	4970	4040	5730	3610	9660	7760	5330	1600	−940	1780	2000

CURVES DERIVED FROM FORMULÆ ON PAGES 70 AND 71

REDUCED TO 16,000 BASE UNIT

From Bulletin No. 41 of the American Railway Engineering and Maintenance of Way Association

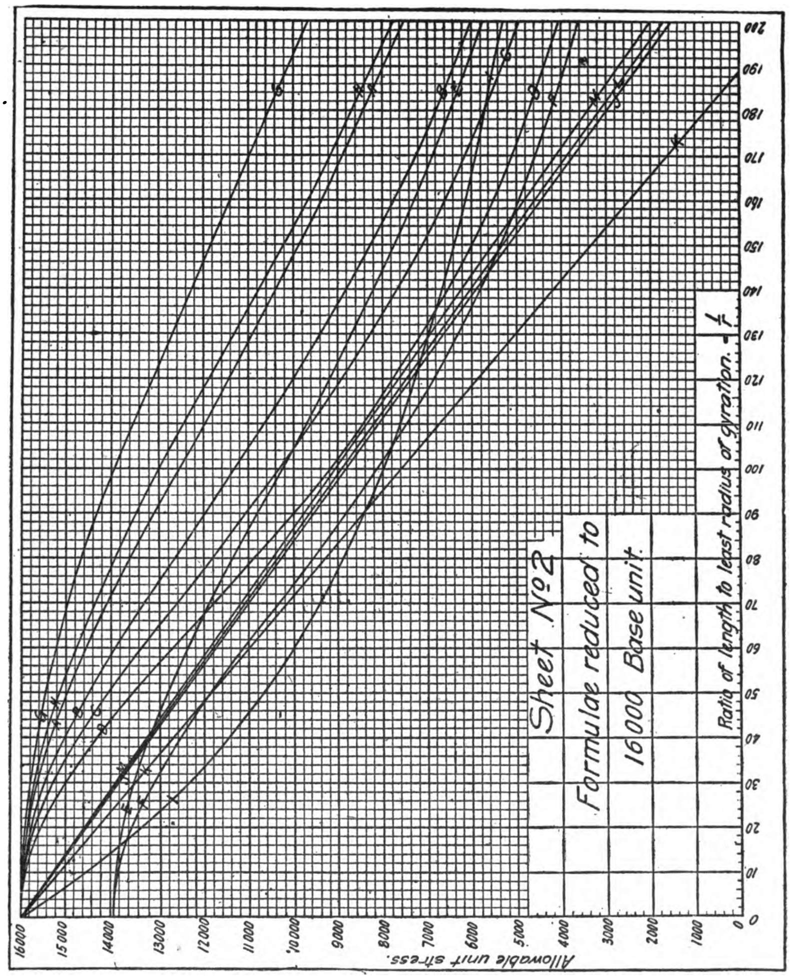


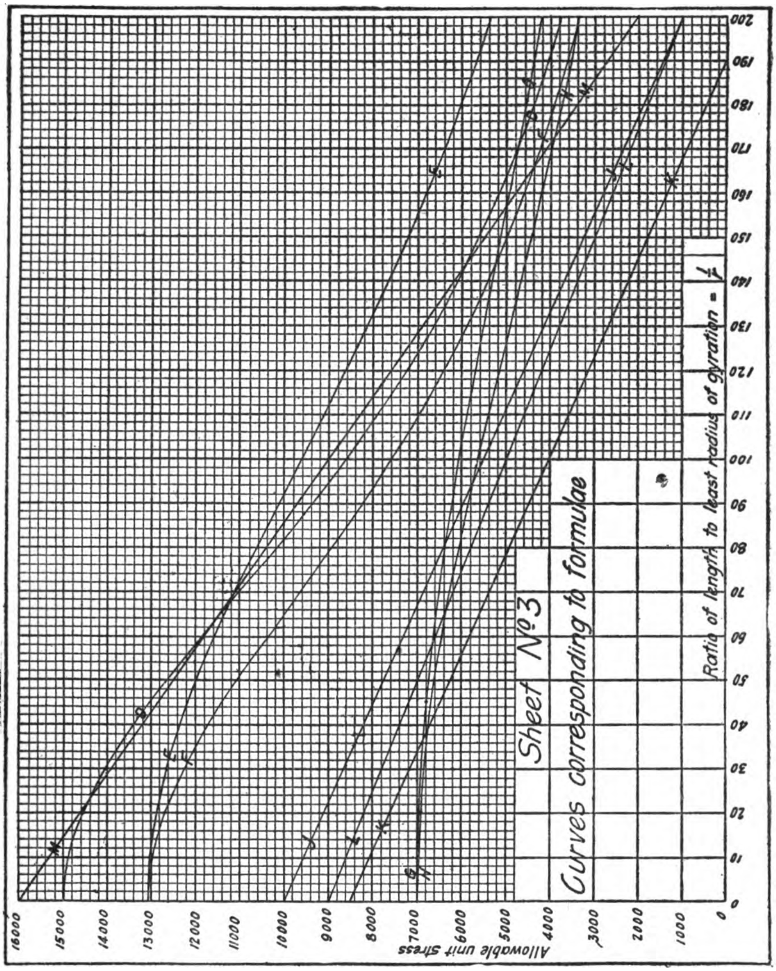
TABLE 31

VALUES CORRESPONDING TO FORMULÆ ON PAGES 70 AND 71

AND TO CURVES ON SHEET NO. 3

$\frac{l}{r}$	A	B	C	D	E	F	G	H	J	K	L	M
0	50000	50000	50000	15000	13050	13050	7000	7000	10000	8500	9000	16000
10	49860	49790	49720	14890	13000	12960	6990	6980	9550	8050	8600	15300
20	49450	49180	48910	14570	12870	12690	6960	6940	9100	7600	8200	14600
30	48780	48200	47620	14060	12640	12260	6910	6860	8650	7150	7800	13900
40	47880	46880	45920	13410	12350	11710	6840	6750	8200	6700	7400	13200
50	46770	45280	43900	12660	11980	11070	6750	6620	7750	6250	7000	12500
60	45460	43480	41670	11840	11560	10380	6650	6460	7300	5800	6600	11800
70	44010	41520	39300	11010	11110	9670	6530	6280	6850	5350	6200	11100
80	42450	39480	36880	10180	10620	8960	6390	6080	6400	4900	5800	10400
90	40820	37380	34480	9370	10120	8270	6240	5870	5950	4450	5400	9700
100	39130	35300	32140	8620	9620	7610	6080	5640	5500	4000	5000	9000
110	37420	33240	29900	7910	9110	7000	5910	5410	5050	3550	4600	8300
120	35720	31250	27780	7260	8620	6430	5730	5170	4600	3100	4200	7600
130	34030	29340	25790	6660	8140	5910	5550	4930	4150	2650	3800	6900
140	32370	27520	23940	6120	7680	5440	5360	4690	3700	2200	3400	6200
150	30770	25810	22220	5630	7240	5010	5170	4460	3250	1750	3000	5500
160	29220	24190	20640	5180	6820	4610	4980	4230	2800	1300	2600	4800
170	27740	22690	19190	4780	6420	4260	4790	4010	2350	850	2200	4100
180	26320	21280	17860	4410	6050	3940	4600	3790	1900	400	1800	3400
190	24970	19970	16640	4080	5700	3650	4410	3590	1450	−50	1400	2700
200	23680	18750	15520	3790	5370	3380	4230	3400	1000	−500	1000	2000

CURVES CORRESPONDING TO FORMULÆ ON PAGES 70 AND 71



Name.	Year.	Grade of Steel.	Elastic Limit.	Safe Tension.	Safe Compression.	Safe Stress Combined.
American Bridge Co.	1900	52000–62000 60000–70000	½ Ult.	15000 17000	$\left\{ \dfrac{15000}{1+\dfrac{l^2}{13500r^2}} \quad \dfrac{17000}{1+\dfrac{l^2}{11000r^2}} \right.$	$D+\frac{3}{4}B$
Theodore Cooper	1901	54000–62000 60000–67000	½ Ult.	Variable	Straight line-Variable	$D+B$
The Osborn Eng. Co.	1903	52000–62000 60000–70000	32000 35000	15000 17000	$\left\{ \dfrac{15000}{1+\dfrac{l^2}{36000r^2}} \quad \dfrac{17000}{1+\dfrac{l^2}{36000r^2}} \right.$	. . .
*A.R.E. & M. of W.A.	1903	55000–65000	28000	16000	$16000 - 70\frac{l}{r}$	. . .
Pennsylvania R.R.	1901	52000–62000	28000	15000	$\left\{ \dfrac{15000}{1+\dfrac{l^2}{13500r^2}} \right.$	$D+\frac{3}{4}B$
N.Y.C. & H.R. R.R.	1902	56000–64000	33000	L.L. – 8000 D.L. – 16000	$\left\{ \dfrac{8000}{1+\dfrac{l^2}{18000r^2}} \quad \dfrac{16000}{1+\dfrac{l^2}{18000r^2}} \right.$	$D+B$
Missouri Pacific	1902	52000–62000 60000–70000	½ Ult.	15000	$17000-80\frac{l}{r}$	. . .

D = direct stress in pounds per square inch.
B = extreme fiber stress in pounds per square inch.
$L.L.$ = live load.
$D.L.$ = dead load.

* American Railway Engineering and Maintenance of Way Association

HIGHWAY BRIDGE SPECIFICATIONS

Name.	Year.	Grade of Steel.	Elastic Limit.	Safe Tension.	Safe Compression.	Safe Stress Combined.
American Bridge Co.	1901	52000–62000 60000–70000	½ Ult.	15000 17000	$\left\{ \dfrac{15000}{1+\dfrac{l^2}{13500r^2}} \quad \dfrac{17000}{1+\dfrac{l^2}{11000r^2}} \right.$	$D+\frac{3}{4}B$
Theodore Cooper	1901	54000–62000 60000–68000	½ Ult.	Variable	Straight line-Variable	$D+B$
The Osborn Eng. Co.	1901	52000–62000 60000–70000	32000 35000	20000 22000	$\left\{ \dfrac{20000}{1+\dfrac{l^2}{36000r^2}} \quad \dfrac{22000}{1+\dfrac{l^2}{36000r^2}} \right.$	$D+B$

BUILDING SPECIFICATIONS

Name.	Year.	Grade of Steel.	Elastic Limit.	Safe Tension.	Safe Compression.	Safe Stress Combined.
Charles Evan Fowler	1901	55000–65000	½ Ult.	15000	$12500-41.7\frac{l}{r}$	. . .
C. C. Schneider	1904	55000–65000	28000	16000	$16000-70\frac{l}{r}$	$D+\frac{3}{4}B$
New York Bldg. Law	1899	54000–64000	32000	16000	$15200-58\frac{l}{r}$	. . .
Chicago Bldg. Law	1903	. . .	. .	15000	15000 reduced	. . .

D = direct stress in pounds per square inch.
B = extreme fiber stress in pounds per square inch.
L.L. = live load.
D.L. = dead load.

TABLE 32

SAFE LOADS OF TWO ANGLES

Short legs outstanding

Safe Loads are based on the New York Building Law Formula, $P = 15200 - 58\frac{l}{r}$

Safe Loads given are total safe loads in thousand pounds

For sections to the left of the heavy line $\frac{l}{r}$ **is less than 120**

Least. r	Total Area.	Size of Angles.	b. to b. of Angles.	Unbraced Span in Feet. 4	5	6	7	8	9	10
1.49	14.62	7×3½× ¾	5/8	194.9	188.1	181.2	174.4	167.6	160.8	153.9
1.48	13.50	×11/16	5/8	179.8	173.5	167.1	160.8	154.4	148.1	141.7
1.46	12.34	× 5/8	5/8	164.0	158.2	152.3	146.4	140.5	134.6	128.7
1.40	11.18	×9/16	½	147.7	142.1	136.6	131.0	125.5	119.9	114.3
1.39	10.00	× ½	½	132.0	127.0	122.0	116.9	111.9	106.9	101.9
1.35	8.80	×7/16	7/16	115.6	111.1	106.5	102.0	97.5	92.9	88.4
1.79	13.88	6×4 × ¾	5/8	189.4	184.0	178.6	173.2	167.8	162.4	157.0
1.77	12.82	×11/16	5/8	174.7	169.7	164.6	159.6	154.5	149.5	144.5
1.76	11.72	× 5/8	5/8	159.6	155.0	150.3	145.7	141.1	136.4	131.8
1.70	10.62	×9/16	½	144.0	139.7	135.3	131.0	126.6	122.3	118.0
1.69	9.50	× ½	½	128.8	124.8	120.9	117.0	113.1	109.2	105.3
1.65	8.36	×7/16	7/16	113.0	109.5	105.9	102.4	98.9	95.3	91.8
1.62	7.22	× 3/8	3/8	97.3	94.2	91.1	88.0	84.9	81.8	78.7
1.56	9.84	5×3½× 5/8	5/8	132.0	127.6	123.2	118.8	114.4	110.1	105.7
1.55	8.94	×9/16	½	119.8	115.8	111.8	107.8	103.8	99.8	95.8
1.54	8.00	× ½	½	107.1	103.5	99.9	96.3	92.7	89.1	85.4
1.50	7.06	×7/16	7/16	94.2	90.9	87.6	84.4	81.1	77.8	74.5
1.46	6.10	× 3/8	3/8	81.1	78.2	75.3	72.4	69.5	66.6	63.6
1.43	5.12	×5/16	5/16	67.9	65.4	62.9	60.4	57.9	55.4	52.9
1.24	7.24	4×3 ×9/16	9/16	93.8	89.7	85.7	81.6	77.5	73.5	69.4
1.25	6.50	× ½	½	84.3	80.7	77.1	73.5	69.8	66.2	62.6
1.25	5.74	×7/16	7/16	74.5	71.3	68.1	64.9	61.7	58.5	55.3
1.26	4.96	× 3/8	3/8	64.4	61.7	59.0	56.2	53.5	50.7	48.0
1.27	4.18	×5/16	5/16	54.4	52.1	49.8	47.5	45.2	42.9	40.6
.91	5.00	3×2½× ½	½	60.7	56.9	53.1	49.2	45.4	41.6	37.8
.92	4.44	×7/16	7/16	54.1	50.7	47.3	44.0	40.6	37.3	33.9
.93	3.84	× 3/8	3/8	46.9	44.0	41.1	38.3	35.4	32.5	29.6
.94	3.24	×5/16	5/16	39.7	37.3	34.9	32.5	30.1	27.7	25.3
.95	2.62	× ¼	5/16	32.1	30.2	28.3	26.4	24.5	22.5	20.6
.77	3.10	2½×2× 3/8	3/8	35.9	33.1	30.3	27.5	24.7	21.9	19.1
.78	2.62	×5/16	5/16	30.5	28.1	25.8	23.5	21.1	18.8	16.5
.78	2.12	× ¼	5/16	24.7	22.8	20.9	19.0	17.1	15.2	13.3
.79	1.62	×3/16	¼	18.9	17.5	16.1	14.6	13.2	11.8	10.4

AS COLUMNS OR STRUTS

Short legs outstanding

Safe Loads are based on the New York Building Law Formula, $P = 15200 - 58\frac{l}{r}$

Safe Loads given are total safe loads in thousand pounds

For sections to the left of the heavy line $\frac{l}{r}$ **is less than 120**

Unbraced Span in Feet.										
11	12	14	16	18	20	22	24	26	28	30
147.1	140.3	126.6	113.0	99.3	85.6	72.0	58.3	44.7		
135.4	129.0	116.3	103.6	90.9	78.2	65.5	52.8	40.1		
122.9	117.0	105.2	93.4	81.7	69.9	58.1	46.4	34.6		
108.8	103.2	92.1	81.0	69.9	58.8	47.7	36.5	25.4		
96.9	91.9	81.9	71.9	61.9	51.9	41.8	31.8	21.8		
83.9	79.3	70.2	61.2	52.1	43.0	34.0	24.9	15.8		
151.6	146.2	135.4	124.6	113.8	103.0	92.2	81.4	70.7	59.9	49.1
139.4	134.4	124.3	114.2	104.1	94.0	84.0	73.9	63.8	53.7	43.6
127.2	122.5	113.3	104.0	94.7	85.4	76.2	66.9	57.6	48.4	39.1
113.6	109.3	100.6	91.9	83.2	74.5	65.9	57.2	48.5	39.8	31.1
101.4	97.4	89.6	81.8	74.0	66.1	58.3	50.5	42.7	34.8	27.0
88.3	84.8	77.7	70.7	63.6	56.5	49.5	42.4	35.4	28.3	21.3
75.6	72.5	66.3	60.1	53.9	47.6	41.4	35.2	29.0	22.8	16.6
101.3	96.9	88.1	79.3	70.5	61.8	53.0	44.2	35.4		
91.7	87.7	79.7	71.7	63.6	55.6	47.6	39.6	31.5		
81.8	78.2	71.0	63.8	56.5	49.3	42.1	34.8	27.6		
71.3	68.0	61.4	54.9	48.3	41.8	35.2	28.7	22.1		
60.7	57.8	52.0	46.2	40.4	34.6	28.7	22.9	17.1		
50.4	47.9	42.9	38.0	33.0	28.0	23.0	18.0	13.0		
65.4	61.3	53.2	45.0	36.9	28.8					
59.0	55.4	48.1	40.9	33.7	26.4					
52.1	48.9	42.5	36.1	29.7	23.3					
45.3	42.5	37.0	31.6	26.1	20.6					
38.3	36.1	31.5	26.9	22.3	17.7					
33.9	30.1	22.5								
30.6	27.2	20.5								
26.8	23.9	18.1								
22.9	20.5	15.7								
18.7	16.8	12.9								

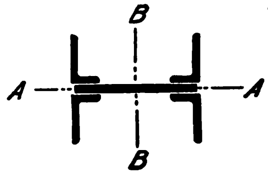


TABLE 33

SAFE LOADS OF ANGLE AND PLATE COLUMNS. 8-INCH PLATES

8½″ b. to b. of angles, for 6 × 4 angles
8¼″ b. to b. of angles, for 5 × 3½ and 4 × 3 angles
Long legs of angles outstanding
Safe loads are based on New York Building Law Formula
Safe loads given are total safe loads in thousand pounds

For sections to the left of the heavy line, $\frac{l}{r}$ is less than 120

Size of Angles.	Thickness of Plate.	Total Area.	Axis BB.		Axis AA.		Unbraced Span in Feet.											
			I	r	I	r	9	10	11	12	13	14	16	18	20	22	24	26
6×4 × ¾	¾	33.76	345.68	3.20	265.63	2.81	437.9	429.5	421.2	412.8	404.4	396.1	379.4	362.6	345.9	329.2	312.5	295.7
× 11/16	⅝	30.64	320.02	. .	235.76	2.77	396.4	388.7	381.0	373.3	365.6	357.9	342.5	327.1	311.7	296.3	280.9	265.5
× ⅝	⅝	28.44	299.78	. .	213.06	2.74	367.3	360.1	352.8	345.6	338.4	331.2	316.7	302.3	287.8	273.4	258.9	244.5
× 9/16	½	25.24	271.94	. .	185.61	2.71	325.3	318.8	312.4	305.9	299.4	292.9	279.9	267.0	254.0	241.1	228.1	215.1
× ½	½	23.00	248.34	. .	165.02	2.68	295.8	289.9	283.9	277.9	271.9	266.0	254.0	242.1	230.1	218.2	206.2	194.3
× 7/16	7/16	20.22	222.04	. .	141.26	2.64	259.4	254.0	248.7	243.4	238.1	232.7	222.1	211.4	200.7	190.1	179.4	168.8
× ⅜	⅜	17.44	193.81	3.33	119.27	2.62	223.4	218.8	214.1	209.5	204.9	200.2	191.0	181.7	172.4	163.2	153.9	144.7
5×3½× ⅝	⅝	24.68	244.37	3.15	127.99	2.28	307.3	299.7	292.3	284.7	277.2	269.7	254.6	239.5	224.4			
× 9/16	½	21.88	221.65	. .	110.80	2.25	271.7	264.9	258.1	251.4	244.6	237.8	224.3	210.8	197.2			
× ½	½	20.00	202.91	. .	98.41	2.22	247.6	241.3	235.0	228.8	222.5	216.2	203.7	191.1	178.6			
× 7/16	7/16	17.62	181.87	. .	83.91	2.18	217.2	211.6	205.9	200.3	194.7	189.1	177.7	166.6	155.3			
× ⅜	⅜	15.20	158.77	. .	70.57	2.15	186.8	181.8	176.9	172.0	167.1	162.2	152.3	142.5	132.6			
× 5/16	5/16	12.74	134.72	3.25	57.65	2.13	156.2	152.0	147.8	143.7	139.5	135.4	127.0	118.7	110.4			
4×3 × 9/16	½	18.48	187.28	3.18	59.34	1.79	216.2	209.0	201.9	194.7	187.5	180.3	165.9					
× ½	½	17.00	172.15	. .	52.74	1.76	197.9	191.2	184.4	177.7	171.0	164.3	150.8					
× 7/16	7/16	14.98	154.30	. .	44.61	1.73	173.5	167.4	161.4	155.4	149.4	143.3	131.3					
× ⅜	⅜	12.92	134.68	. .	37.24	1.70	148.8	143.5	138.2	132.9	127.6	122.3	111.8					
× 5/16	5/16	10.86	114.60	3.26	30.31	1.67	124.3	119.8	115.3	110.8	106.2	101.7	92.6					

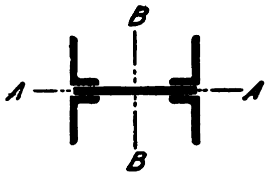


TABLE 34

SAFE LOADS OF ANGLE AND PLATE COLUMNS. 12-INCH PLATES

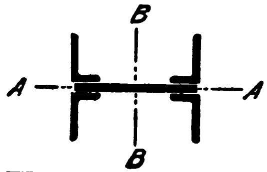
$12\frac{1}{2}''$ b. to b. of angles, long legs outstanding
Safe loads are based on New York Building Law Formula
Safe loads given are total safe loads in thousand pounds

For sections to the left of the heavy line $\frac{l}{r}$ is less than 120

Size of Angles.	Thickness of Plate.	Total Area.	Axis BB. I	Axis BB. r	Axis AA. I	Axis AA. r	Unbraced Span in Feet. 9	10	11	12	13	14	16	18	20	22	24	26
6×4 × $\frac{3}{4}$	$\frac{3}{4}$	36.76	849.27	4.81	265.77	2.69	473.1	463.6	454.1	444.6	435.1	425.6	406.6	387.5	368.5	349.5	330.5	311.5
× $\frac{11}{16}$	$\frac{5}{8}$	33.14	780.21	. .	235.84	2.67	426.0	417.3	408.7	400.1	391.4	382.8	365.5	348.2	331.0	313.7	296.4	279.1
× $\frac{5}{8}$	$\frac{5}{8}$	30.94	728.56	. .	213.14	2.62	396.3	388.1	379.9	371.7	363.4	355.2	338.8	322.3	305.9	289.5	273.0	256.6
× $\frac{9}{16}$	$\frac{1}{2}$	27.24	655.35	. .	185.65	2.61	348.7	341.4	334.1	326.9	319.6	312.4	297.8	283.3	268.8	254.2	239.7	225.2
× $\frac{1}{2}$	$\frac{1}{2}$	25.00	598.08	. .	165.06	2.57	319.1	312.3	305.5	298.8	292.0	285.2	271.7	258.1	244.6	231.1	217.5	204.0
× $\frac{7}{16}$	$\frac{7}{16}$	21.97	531.44	. .	141.29	2.54	279.8	273.7	267.7	261.7	255.7	249.7	237.6	225.6	213.5	201.5	189.5	177.4
× $\frac{3}{8}$	$\frac{3}{8}$	18.94	461.81	4.94	119.29	2.51	240.6	235.4	230.1	224.9	219.6	214.4	203.9	193.3	182.8	172.3	161.8	151.3
5×3½× $\frac{5}{8}$	$\frac{5}{8}$	27.18	636.36	4.84	128.07	2.17	334.7	326.0	317.2	308.5	299.8	291.1	273.7	256.2	238.8			
× $\frac{9}{16}$	$\frac{1}{2}$	23.88	572.35	. .	110.85	2.15	293.4	285.7	277.9	270.2	262.5	254.8	239.3	223.8	208.4			
× $\frac{1}{2}$	$\frac{1}{2}$	22.00	523.34	. .	98.46	2.12	269.4	262.2	255.0	247.7	240.5	233.3	218.8	204.4	189.9			
× $\frac{7}{16}$	$\frac{7}{16}$	19.37	465.96	. .	83.94	2.08	236.1	229.6	223.1	216.6	210.1	203.7	190.7	177.8	164.8			
× $\frac{3}{8}$	$\frac{3}{8}$	16.70	404.91	. .	70.59	2.06	203.	197.4	191.8	186.1	180.5	174.8	163.6	152.3	141.0			
× $\frac{5}{16}$	$\frac{5}{16}$	13.99	341.90	4.94	57.66	2.03	169.5	164.7	159.9	155.1	150.3	145.5	135.9	126.3	116.7			
4×3 × $\frac{9}{16}$	$\frac{1}{2}$	20.48	485.56	4.87	59.40	1.70	235.8	227.4	219.1	210.7	202.3	193.9	177.1					
× $\frac{1}{2}$	$\frac{1}{2}$	19.00	446.16	. .	52.78	1.67	217.5	209.6	201.7	193.8	185.9	177.9	162.1					
× $\frac{7}{16}$	$\frac{7}{16}$	16.73	397.24	. .	44.64	1.63	190.0	182.9	175.7	168.6	161.4	154.3	140.0					
× $\frac{3}{8}$	$\frac{3}{8}$	14.42	345.08	. .	37.25	1.61	163.1	156.8	150.6	144.4	138.1	131.9	119.4					
× $\frac{5}{16}$	$\frac{5}{16}$	12.11	292.23	4.91	30.32	1.58	136.1	130.7	125.4	120.1	114.7	109.4	98.7					

TABLE 35

SAFE LOADS FOR ANGLE AND PLATE COLUMNS. 18-INCH PLATES



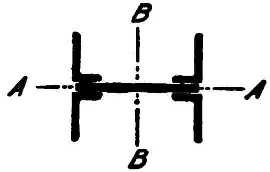
18¼ b. to b. of angles, long legs outstanding
Safe loads are based on New York Building Law Formula
Safe loads given are total safe loads in thousand pounds

For sections to the left of the heavy line, $\frac{l}{r}$ is less than 120

Size of Angles.	Thickness of Plate.	Total Area.	Axis BB. I	Axis BB. r	Axis AA. I	Axis AA. r	Unbraced Span in Feet. 10	12	14	16	18	20	22	24	26
6×4× ¾	¾	41.26	2195.90	7.30	265.98	2.54	514.1	491.5	468.9	446.3	423.7	401.0	378.4	355.8	333.2
× 11/16	⅝	36.89	2003.92	. .	235.97	2.53	459.2	438.9	418.7	398.4	378.1	357.8	337.5	317.2	296.9
× ⅝	⅝	34.69	1869.83	. .	213.27	2.48	429.8	410.3	390.8	371.3	351.8	332.3	312.8	293.3	273.8
× 9/16	½	30.24	1669.36	. .	185.71	2.48	374.8	357.8	340.8	323.9	306.9	289.9	273.0	256.0	239.0
× ½	½	28.00	1525.47	. .	165.12	2.43	345.4	329.4	313.3	297.3	281.2	265.2	249.2	233.1	217.1
× 7/16	7/16	24.60	1349.70	. .	141.33	2.40	302.6	288.3	274.0	259.8	245.5	231.2	217.0	202.7	188.4
× ⅜	⅜	21.19	1169.25	7.43	119.32	2.37	259.9	247.4	235.0	222.5	210.1	197.6	185.2	172.7	160.3
5×3½× ⅝	⅝	30.93	1638.30	7.28	128.19	2.04	364.6	343.5	322.4	301.3	280.2	259.1			
× 9/16	½	26.88	1461.59	. .	110.91	2.03	316.4	298.0	279.5	261.1	242.7	224.3			
× ½	½	25.00	1338.98	. .	98.52	1.99	292.6	275.1	257.6	240.1	222.6	205.1			
× 7/16	7/16	22.00	1187.02	. .	83.98	1.95	255.9	240.2	224.5	208.8	193.1	177.4			
× ⅜	⅜	18.95	1028.35	. .	70.62	1.93	219.7	206.0	192.4	178.7	165.0	151.4			
× 5/16	5/16	15.87	865.64	7.39	57.67	1.91	183.4	171.8	160.3	148.7	137.1	125.6			

TABLE 36

SAFE LOADS OF ANGLE AND PLATE COLUMNS. 24-INCH PLATES.



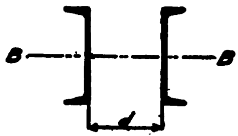
$24\frac{1}{4}''$ b. to b. of angles, long legs outstanding
Safe loads are based on New York Building Law Formula
Safe loads given are total safe loads in thousand pounds

For sections to the left of the heavy line, $\frac{l}{r}$ is less than 120

Size of Angles.	Thickness of Plate.	Total Area.	Axis BB.		Axis AA.		Unbraced Span in Feet.								
			I	r	I	r	10	12	14	16	18	20	22	24	26
6×4× $\frac{3}{4}$	$\frac{3}{4}$	45.76	4285.22	9.68	266.19	2.41	563.4	537.0	510.5	484.1	457.7	431.2	404.8	378.4	351.9
× $\frac{11}{16}$	$\frac{5}{8}$	40.64	3891.65	. .	236.09	2.41	500.4	476.9	453.4	429.9	406.5	383.0	359.5	336.0	312.6
× $\frac{5}{8}$	$\frac{5}{8}$	38.44	3635.52	. .	213.39	2.36	470.9	448.3	425.6	402.9	380.2	357.6	334.9	312.2	289.6
× $\frac{9}{16}$	$\frac{1}{2}$	33.24	3227.70	. .	185.78	2.36	407.2	387.6	368.0	348.4	328.8	309.2	289.6	270.0	250.4
× $\frac{1}{2}$	$\frac{1}{2}$	31.00	2956.86	. .	165.18	2.31	377.8	359.1	340.4	321.8	303.1	284.4	265.7	247.0	228.4
× $\frac{7}{16}$	$\frac{7}{16}$	27.22	2610.67	. .	141.38	2.28	330.6	314.0	297.4	280.8	264.2	247.6	230.9	214.3	197.7
× $\frac{3}{8}$	$\frac{3}{8}$	23.44	2258.11	9.82	119.34	2.26	284.1	269.7	255.2	240.8	226.3	211.9	197.5	183.0	168.6
5×3½× $\frac{5}{8}$	$\frac{5}{8}$	34.68	3196.97	9.60	128.31	1.92	401.4	376.3	351.1	326.0	300.8	275.7			
× $\frac{9}{16}$	$\frac{1}{2}$	29.88	2834.67	. .	110.97	1.93	346.4	324.9	303.3	281.8	260.2	238.7			
× $\frac{1}{2}$	$\frac{1}{2}$	28.00	2604.62	. .	98.58	1.88	321.9	301.2	280.5	259.8	239.0	218.3			
× $\frac{7}{16}$	$\frac{7}{16}$	24.62	2303.99	. .	84.03	1.85	281.6	263.1	244.6	226.0	207.5	189.0			
× $\frac{3}{8}$	$\frac{3}{8}$	21.20	1992.90	. .	70.64	1.83	241.6	225.5	209.4	193.2	177.1	161.0			
× $\frac{5}{16}$	$\frac{5}{16}$	17.74	1674.96	9.72	57.69	1.80	201.1	187.3	173.6	159.9	146.2	132.5			

TABLE 37

SAFE LOADS FOR



Safe loads are based on New York Building Law Formula
Safe loads given are total safe loads in thousand pounds
For sections to the left of the heavy line, $\frac{l}{r}$ is less than 120
d = Distance back to back in inches to make r equal about both axes

Size of Channel.		Total Area.	r about Axis BB.	d.	Unbraced Span in Feet.			
Depth.	Weight.				8	10	12	14
15	55	32.36	5.16	8.53	457.0	448.2	439.5	430.8
"	50	29.42	5.23	8.71	415.9	408.0	400.2	392.4
"	45	26.48	5.32	8.92	374.8	367.8	360.9	354.0
"	40	23.52	5.43	9.15	333.4	327.4	321.3	315.3
"	35	20.58	5.58	9.43	292.3	287.1	282.0	276.8
"	33	19.80	5.62	9.50	281.3	276.4	271.5	266.6
12	40	23.52	4.09	6.60	325.5	317.5	309.5	301.5
"	35	20.58	4.17	6.81	285.3	278.5	271.6	264.7
"	30	17.64	4.28	7.07	245.2	239.4	233.7	228.0
"	25	14.70	4.43	7.36	205.0	200.3	195.7	191.1
"	20.50	12.06	4.61	7.67	168.7	165.1	161.5	157.8
10	25	14.70	3.52	5.67	200.2	194.4	188.6	182.7
"	20	11.76	3.66	5.97	160.9	156.4	151.9	147.4
"	15	8.92	3.87	6.33	122.7	119.5	116.3	113.1
9	20	11.76	3.21	5.12	158.3	153.2	148.2	143.1
"	15	8.82	3.40	5.49	119.6	116.0	112.4	108.8
"	13.25	7.78	3.49	5.63	105.8	102.7	99.6	96.5
8	16.25	9.56	2.89	4.54	126.9	122.3	117.7	113.1
"	13.75	8.08	2.98	4.72	107.7	103.9	100.2	96.4
"	11.25	6.70	3.11	4.94	89.8	86.8	83.8	80.8
7	14.75	8.68	2.50	3.80	112.6	107.8	102.9	98.1
"	12.25	7.20	2.59	3.99	94.0	90.1	86.2	82.4
"	9.75	5.70	2.72	4.22	75.0	72.1	69.1	66.2
6	13	7.64	2.13	3.09	96.2	91.2	86.2	81.2
"	10.50	6.18	2.21	3.28	78.4	74.5	70.6	66.7
"	8	4.76	2.34	3.52	61.0	58.2	55.4	52.5
5	9	5.30	1.83	2.56	64.4	60.4	56.4	52.3
"	6.50	3.90	1.95	2.79	48.1	45.4	42.6	39.8
4	5.25	3.10	1.56	2.06	36.1	33.3	30.5	27.8

LACED CHANNEL COLUMNS

Safe loads are based on New York Building Law Formula
Safe loads given are total safe loads in thousand pounds
For sections to the left of the heavy line, $\frac{l}{r}$ is less than 120
d = Distance back to back in inches to make r equal about both axes

Unbraced Span in Feet.							
16	18	20	22	24	26	28	30
422.0	413.3	404.6	395.9	387.1	378.4	369.7	360.9
384.5	376.7	368.9	361.1	353.2	345.4	337.6	329.7
347.1	340.1	333.2	326.3	319.4	312.4	305.5	298.6
309.3	303.2	297.2	291.2	285.1	279.1	273.1	267.1
271.7	266.6	261.5	256.3	251.2	246.1	240.9	235.8
261.7	256.8	251.9	247.0	242.1	237.2	232.3	227.4
293.5	285.5	277.5	269.5	261.5	253.5	245.4	237.4
257.9	251.0	244.1	237.2	230.4	223.5	216.6	209.8
222.2	216.5	210.8	205.0	199.3	193.5	187.8	182.1
186.5	181.9	177.3	172.6	168.0	163.4	158.8	154.2
154.2	150.5	146.9	143.3	139.6	136.0	132.3	128.7
176.9	171.1	165.3	159.5	153.7	147.9	142.1	136.2
143.0	138.5	134.0	129.6	125.1	120.6	116.1	111.7
109.9	106.7	103.5	100.3	97.1	93.9	90.7	87.5
138.0	132.9	127.8	122.7	117.6	112.5	107.4	102.3
105.2	101.6	98.0	94.3	90.7	87.1	83.5	79.9
93.4	90.3	87.2	84.1	81.0	77.9	74.8	71.7
108.5	103.9	99.3	94.7	90.1	85.4	80.8	
92.6	88.8	85.1	81.3	77.5	73.8	70.0	
77.9	74.9	71.9	68.9	65.9	62.9	59.9	56.9
93.3	88.4	83.6	78.8	73.9			
78.5	74.6	70.7	66.9	63.0			
63.3	60.4	57.5	54.6	51.6	48.7		
76.2	71.2	66.2					
62.8	58.9	55.0	51.1				
49.7	46.9	44.0	41.2				
48.3	44.3						
37.0	34.2						

TABLE 38

STRESS DUE TO WEIGHT OF SECTION

The extreme fiber stress due to the weight of a member may be determined by the formula given below. The general formula and table are based on the member acting as a beam supported at the two ends. The bending produced for the horizontal span L is the same whether the member is horizontal or inclined.

Let R = extreme fiber stress in pounds per square inch,
L = simple horizontal span in feet,
r = radius of gyration of section about axis at right angles to load,
e = distance in inches from neutral axis to extreme fiber in question,

Then $R = \frac{5.1\, eL^2}{r^2}$.

Since bending produces compression in the upper fiber and tension in the lower fiber; for members having direct compressive stress, R for the upper fiber is added to the direct compression in pounds per sq. in.; for members having direct tensile stress, R for the lower fiber is added to the direct tension in pounds per sq. in. See combined stresses under specifications.

In the above formula R varies directly as e and inversely as r^2; it is therefore important that r should be as large as possible and that e should be as small as possible for a given section.

The following table gives values of R for tension and compression members. For angles subject to direct compression the angle is placed thus  For angles subject to direct tension the angle is placed thus

STRESS DUE TO WEIGHT FOR ANGLES

EXTREME FIBER STRESS IN POUNDS PER SQUARE INCH

Size of Angle.	Area.	e	r	Simple Horizontal Span in Feet.												
				6	8	10	12	14	16	18	20	22	24	26	28	30
6×4 × 5/8	5.86	2.03	1.90	100	180	290	410	560	740	930	1150	1390	1650	1940	2250	2580
× 1/2	4.75	1.99	1.91	100	180	280	400	550	710	900	1110	1350	1600	1880	2180	2500
× 7/16	4.18	1.96	1.92	100	170	270	390	530	690	880	1080	1310	1560	1830	2120	2440
× 3/8	3.61	1.94	1.93	100	170	270	380	520	680	860	1060	1280	1530	1790	2080	2390
5×3½ × 1/2	4.00	1.66	1.58	120	220	340	490	660	870	1100	1360	1640	1950	2290	2660	3050
× 7/16	3.53	1.63	1.59	120	210	330	470	650	840	1070	1320	1590	1900	2220	2580	2960
× 3/8	3.05	1.61	1.60	120	210	320	460	630	820	1040	1280	1550	1850	2170	2520	2890
× 5/16	2.56	1.59	1.61	110	200	310	450	610	800	1010	1250	1520	1800	2120	2450	2820
4×4 × 1/2	3.75	1.18	1.22	150	260	400	580	790	1030	1310	1620	1960	2330	2730	3170	3640
× 7/16	3.31	1.16	1.23	140	250	390	560	770	1000	1270	1560	1890	2250	2640	3070	3520
× 3/8	2.86	1.14	1.23	140	250	380	550	750	980	1240	1540	1860	2210	2600	3010	3460
× 5/16	2.40	1.12	1.24	130	240	370	530	730	950	1200	1480	1800	2140	2510	2910	3340
4×3 × 7/16	2.87	1.30	1.25	150	270	420	610	830	1090	1370	1700	2050	2440	2870	3320	3820
× 3/8	2.48	1.28	1.26	150	260	410	590	810	1050	1330	1640	1990	2370	2780	3220	3700
× 5/16	2.09	1.26	1.27	140	260	400	570	780	1020	1290	1590	1930	2290	2690	3120	3580
3×3 × 3/8	2.11	.89	.91	200	350	550	790	1070	1400	1780	2190	2650	3160	3700	4300	4930
× 5/16	1.78	.87	.92	190	340	520	750	1030	1340	1700	2100	2540	3020	3540	4110	4720
× 1/4	1.44	.84	.93	180	320	500	710	970	1270	1600	1980	2400	2850	3350	3880	4460
3×2½ × 3/8	1.92	.96	.93	200	360	570	820	1110	1450	1830	2260	2740	3260	3830	4440	5090
× 5/16	1.62	.93	.94	190	340	540	770	1050	1380	1740	2150	2600	3090	3630	4210	4830
× 1/4	1.31	.91	.95	190	330	510	740	1010	1320	1670	2060	2490	2960	3470	4030	4630
2½×2 × 5/16	1.31	.81	.78	240	440	680	980	1330	1740	2200	2720	3290	3910	4590	5320	6110
× 1/4	1.06	.79	.78	240	420	660	950	1300	1700	2150	2650	3200	3810	4480	5190	5960

TABLE 39 (*Continued on pages 88 and 89*)

AREA OF ONE PLATE

Width of Plate.	Thickness of Plate.															
	$\frac{1}{16}$	$\frac{1}{8}$	$\frac{3}{16}$	$\frac{1}{4}$	$\frac{5}{16}$	$\frac{3}{8}$	$\frac{7}{16}$	$\frac{1}{2}$	$\frac{9}{16}$	$\frac{5}{8}$	$\frac{11}{16}$	$\frac{3}{4}$	$\frac{13}{16}$	$\frac{7}{8}$	$\frac{15}{16}$	1
60	3.75	7.50	11.25	15.00	18.75	22.50	26.25	30.00	33.75	37.50	41.25	45.00	48.75	52.50	56.25	60.00
59	3.69	7.38	11.06	14.75	18.44	22.13	25.81	29.50	33.19	36.88	40.56	44.25	47.94	51.63	55.31	59.00
58	3.63	7.25	10.88	14.50	18.13	21.75	25.38	29.00	32.63	36.25	39.88	43.50	47.13	50.75	54.38	58.00
57	3.56	7.13	10.69	14.25	17.81	21.38	24.94	28.50	32.06	35.63	39.19	42.75	46.31	49.88	53.44	57.00
56	3.50	7.00	10.50	14.00	17.50	21.00	24.50	28.00	31.50	35.00	38.50	42.00	45.50	49.00	52.50	56.00
55	3.44	6.88	10.31	13.75	17.19	20.63	24.06	27.50	30.94	34.38	37.81	41.25	44.69	48.13	51.56	55.00
54	3.38	6.75	10.13	13.50	16.88	20.25	23.63	27.00	30.38	33.75	37.13	40.50	43.88	47.25	50.63	54.00
53	3.31	6.63	9.94	13.25	16.56	19.88	23.19	26.50	29.81	33.13	36.44	39.75	43.06	46.38	49.69	53.00
52	3.25	6.50	9.75	13.00	16.25	19.50	22.75	26.00	29.25	32.50	35.75	39.00	42.25	45.50	48.75	52.00
51	3.19	6.38	9.56	12.75	15.94	19.13	22.31	25.50	28.69	31.88	35.06	38.25	41.44	44.63	47.81	51.00
50	3.13	6.25	9.38	12.50	15.63	18.75	21.88	25.00	28.13	31.25	34.38	37.50	40.63	43.75	46.88	50.00
49	3.06	6.13	9.19	12.25	15.31	18.38	21.44	24.50	27.56	30.63	33.69	36.75	39.81	42.88	45.94	49.00
48	3.00	6.00	9.00	12.00	15.00	18.00	21.00	24.00	27.00	30.00	33.00	36.00	39.00	42.00	45.00	48.00
47	2.94	5.88	8.81	11.75	14.69	17.63	20.56	23.50	26.44	29.38	32.31	35.25	38.19	41.13	44.06	47.00
46	2.88	5.75	8.63	11.50	14.38	17.25	20.13	23.00	25.88	28.75	31.63	34.50	37.38	40.25	43.13	46.00
45	2.81	5.63	8.44	11.25	14.06	16.88	19.69	22.50	25.31	28.13	30.94	33.75	36.56	39.38	42.19	45.00
44	2.75	5.50	8.25	11.00	13.75	16.50	19.25	22.00	24.75	27.50	30.25	33.00	35.75	38.50	41.25	44.00
43	2.69	5.38	8.06	10.75	13.44	16.13	18.81	21.50	24.19	26.88	29.56	32.25	34.94	37.63	40.31	43.00
42	2.63	5.25	7.88	10.50	13.13	15.75	18.38	21.00	23.63	26.25	28.88	31.50	34.13	36.75	39.38	42.00
41	2.56	5.13	7.69	10.25	12.81	15.38	17.94	20.50	23.06	25.63	28.19	30.75	33.31	35.88	38.44	41.00

TABLE 39 (*Continued*)

AREA OF ONE PLATE

Width of Plate.	Thickness of Plate.															
	$\frac{1}{16}$	$\frac{1}{8}$	$\frac{3}{16}$	$\frac{1}{4}$	$\frac{5}{16}$	$\frac{3}{8}$	$\frac{7}{16}$	$\frac{1}{2}$	$\frac{9}{16}$	$\frac{5}{8}$	$\frac{11}{16}$	$\frac{3}{4}$	$\frac{13}{16}$	$\frac{7}{8}$	$\frac{15}{16}$	1
40	2.50	5.00	7.50	10.00	12.50	15.00	17.50	20.00	22.50	25.00	27.50	30.00	32.50	35.00	37.50	40.00
39	2.44	4.88	7.31	9.75	12.19	14.63	17.06	19.50	21.94	24.38	26.81	29.25	31.69	34.13	36.56	39.00
38	2.38	4.75	7.13	9.50	11.88	14.25	16.63	19.00	21.38	23.75	26.13	28.50	30.88	33.25	35.63	38.00
37	2.31	4.63	6.94	9.25	11.56	13.88	16.19	18.50	20.81	23.13	25.44	27.75	30.06	32.38	34.69	37.00
36	2.25	4.50	6.75	9.00	11.25	13.50	15.75	18.00	20.25	22.50	24.75	27.00	29.25	31.50	33.75	36.00
35	2.19	4.38	6.56	8.75	10.94	13.13	15.31	17.50	19.69	21.88	24.06	26.25	28.44	30.63	32.81	35.00
34	2.13	4.25	6.38	8.50	10.63	12.75	14.88	17.00	19.13	21.25	23.38	25.50	27.63	29.75	31.88	34.00
33	2.06	4.13	6.19	8.25	10.31	12.38	14.44	16.50	18.56	20.63	22.69	24.75	26.81	28.88	30.94	33.00
32	2.00	4.00	6.00	8.00	10.00	12.00	14.00	16.00	18.00	20.00	22.00	24.00	26.00	28.00	30.00	32.00
31	1.94	3.88	5.81	7.75	9.69	11.63	13.56	15.50	17.44	19.38	21.31	23.25	25.19	27.13	29.06	31.00
30	1.88	3.75	5.63	7.50	9.38	11.25	13.13	15.00	16.88	18.75	20.63	22.50	24.38	26.25	28.13	30.00
29	1.81	3.63	5.44	7.25	9.06	10.88	12.69	14.50	16.31	18.13	19.94	21.75	23.56	25.38	27.19	29.00
28	1.75	3.50	5.25	7.00	8.75	10.50	12.25	14.00	15.75	17.50	19.25	21.00	22.75	24.50	26.25	28.00
27	1.69	3.38	5.06	6.75	8.44	10.13	11.81	13.50	15.19	16.88	18.56	20.25	21.94	23.63	25.31	27.00
26	1.63	3.25	4.88	6.50	8.13	9.75	11.38	13.00	14.63	16.25	17.88	19.50	21.13	22.75	24.38	26.00
25	1.56	3.13	4.69	6.25	7.81	9.38	10.94	12.50	14.06	15.63	17.19	18.75	20.31	21.88	23.44	25.00
24	1.50	3.00	4.50	6.00	7.50	9.00	10.50	12.00	13.50	15.00	16.50	18.00	19.50	21.00	22.50	24.00
23	1.44	2.88	4.31	5.75	7.19	8.63	10.06	11.50	12.94	14.38	15.81	17.25	18.69	20.13	21.56	23.00
22	1.38	2.75	4.13	5.50	6.88	8.25	9.63	11.00	12.38	13.75	15.13	16.50	17.88	19.25	20.63	22.00
21	1.31	2.63	3.94	5.25	6.56	7.88	9.19	10.50	11.81	13.13	14.44	15.75	17.06	18.38	19.69	21.00

TABLE 39 (*Continued*)

AREA OF ONE PLATE

Width of Plate.	Thickness of Plate. 1/16	1/8	3/16	1/4	5/16	3/8	7/16	1/2	9/16	5/8	11/16	3/4	13/16	7/8	15/16	1
20	1.25	2.50	3.75	5.00	6.25	7.50	8.75	10.00	11.25	12.50	13.75	15.00	16.25	17.50	18.75	20.00
19	1.19	2.38	3.56	4.75	5.94	7.13	8.31	9.50	10.69	11.88	13.06	14.25	15.44	16.63	17.81	19.00
18	1.13	2.25	3.38	4.50	5.63	6.75	7.88	9.00	10.13	11.25	12.38	13.50	14.63	15.75	16.88	18.00
17	1.06	2.13	3.19	4.25	5.31	6.38	7.44	8.50	9.56	10.63	11.69	12.75	13.81	14.88	15.94	17.00
16	1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00
15	.94	1.88	2.81	3.75	4.69	5.63	6.56	7.50	8.44	9.38	10.31	11.25	12.19	13.13	14.06	15.00
14	.88	1.75	2.63	3.50	4.38	5.25	6.13	7.00	7.88	8.75	9.63	10.50	11.38	12.25	13.13	14.00
13	.81	1.63	2.44	3.25	4.06	4.88	5.69	6.50	7.31	8.13	8.94	9.75	10.56	11.38	12.19	13.00
12	.75	1.50	2.25	3.00	3.75	4.50	5.25	6.00	6.75	7.50	8.25	9.00	9.75	10.50	11.25	12.00
11	.69	1.38	2.06	2.75	3.44	4.13	4.81	5.50	6.19	6.88	7.56	8.25	8.94	9.63	10.31	11.00
10	.63	1.25	1.88	2.50	3.13	3.75	4.38	5.00	5.63	6.25	6.88	7.50	8.13	8.75	9.38	10.00
9	.56	1.13	1.69	2.25	2.81	3.38	3.94	4.50	5.06	5.63	6.19	6.75	7.31	7.88	8.44	9.00
8	.50	1.00	1.50	2.00	2.50	3.00	3.50	4.00	4.50	5.00	5.50	6.00	6.50	7.00	7.50	8.00
7	.44	.88	1.31	1.75	2.19	2.63	3.06	3.50	3.94	4.38	4.81	5.25	5.69	6.13	6.56	7.00
6	.38	.75	1.13	1.50	1.88	2.25	2.63	3.00	3.38	3.75	4.13	4.50	4.88	5.25	5.63	6.00
5	.31	.63	.94	1.25	1.56	1.88	2.19	2.50	2.81	3.13	3.44	3.75	4.06	4.38	4.69	5.00
4	.25	.50	.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50	2.75	3.00	3.25	3.50	3.75	4.00
3	.19	.38	.56	.75	.94	1.13	1.31	1.50	1.69	1.88	2.06	2.25	2.44	2.63	2.81	3.00
2	.13	.25	.38	.50	.63	.75	.88	1.00	1.13	1.25	1.38	1.50	1.63	1.75	1.88	2.00
1	.06	.13	.19	.25	.31	.38	.44	.50	.56	.63	.69	.75	.81	.88	.94	1.00
3/4	.05	.09	.14	.19	.23	.28	.33	.38	.42	.47	.52	.56	.61	.66	.70	.75
1/2	.03	.06	.09	.13	.16	.17	.22	.25	.28	.31	.34	.38	.41	.44	.47	.50
1/4	.02	.03	.05	.06	.08	.09	.11	.13	.14	.16	.17	.19	.20	.22	.23	.25

TABLE 40

AREA IN SQUARE INCHES DEDUCTED FOR ONE HOLE

Thickness of Metal in Inches.	Diameter of Hole in Inches.															
	$\frac{1}{16}$	$\frac{1}{8}$	$\frac{3}{16}$	$\frac{1}{4}$	$\frac{5}{16}$	$\frac{3}{8}$	$\frac{7}{16}$	$\frac{1}{2}$	$\frac{9}{16}$	$\frac{5}{8}$	$\frac{11}{16}$	$\frac{3}{4}$	$\frac{13}{16}$	$\frac{7}{8}$	$\frac{15}{16}$	1
$\frac{1}{16}$	.004	.008	.012	.016	.020	.023	.027	.031	.035	.039	.043	.047	.051	.055	.059	.063
$\frac{1}{8}$	.008	.016	.023	.031	.039	.047	.055	.063	.070	.078	.086	.094	.102	.109	.117	.125
$\frac{3}{16}$	.012	.023	.035	.047	.059	.070	.082	.094	.105	.117	.129	.141	.152	.164	.176	.188
$\frac{1}{4}$	.016	.031	.047	.063	.078	.094	.109	.125	.141	.156	.172	.188	.203	.219	.234	.250
$\frac{5}{16}$	.020	.039	.059	.078	.098	.117	.137	.156	.176	.195	.215	.234	.254	.273	.293	.313
$\frac{3}{8}$	.023	.047	.070	.094	.117	.141	.164	.188	.211	.234	.258	.281	.305	.328	.352	.375
$\frac{7}{16}$	.027	.055	.082	.109	.137	.164	.191	.219	.246	.273	.301	.328	.355	.383	.410	.438
$\frac{1}{2}$	.031	.063	.094	.125	.156	.188	.219	.250	.281	.313	.344	.375	.406	.438	.469	.500
$\frac{9}{16}$	.035	.070	.105	.141	.176	.211	.246	.281	.316	.352	.387	.422	.457	.492	.527	.563
$\frac{5}{8}$	.039	.078	.117	.156	.195	.234	.273	.313	.352	.391	.430	.469	.508	.547	.586	.625
$\frac{11}{16}$	.043	.186	.129	.172	.215	.258	.301	.344	.387	.430	.473	.516	.559	.602	.645	.688
$\frac{3}{4}$	.047	.094	.141	.188	.234	.281	.328	.375	.422	.469	.516	.563	.609	.656	.703	.750
$\frac{13}{16}$	.051	.102	.152	.203	.254	.305	.355	.406	.457	.508	.559	.609	.660	.711	.762	.813
$\frac{7}{8}$	.055	.109	.164	.219	.273	.328	.383	.438	.492	.547	.602	.656	.711	.766	.820	.875
$\frac{15}{16}$	.059	.117	.176	.234	.293	.352	.410	.469	.527	.586	.645	.703	.762	.820	.879	.938
1	.063	.125	.188	.250	.313	.375	.438	.500	.563	.625	.688	.750	.813	.875	.938	1.000
$1\frac{1}{16}$	.066	.133	.199	.266	.332	.398	.465	.531	.598	.664	.730	.797	.863	.930	.996	1.063
$1\frac{1}{8}$	.070	.141	.211	.281	.352	.422	.492	.563	.633	.703	.773	.844	.914	.984	1.055	1.125
$1\frac{3}{16}$	.074	.148	.223	.297	.371	.445	.520	.594	.668	.742	.816	.891	.965	1.039	1.113	1.188
$1\frac{1}{4}$	.078	.156	.234	.313	.391	.469	.547	.625	.703	.781	.859	.938	1.016	1.094	1.172	1.250
$1\frac{5}{16}$	.082	.164	.246	.328	.410	.492	.574	.656	.738	.820	.902	.984	1.066	1.148	1.230	1.313
$1\frac{3}{8}$	.086	.172	.258	.344	.430	.516	.602	.688	.773	.859	.945	1.031	1.117	1.203	1.289	1.375
$1\frac{7}{16}$	.090	.180	.270	.359	.449	.539	.629	.719	.809	.898	.988	1.078	1.168	1.258	1.348	1.438
$1\frac{1}{2}$	.094	.188	.281	.375	.469	.563	.656	.750	.844	.938	1.031	1.125	1.219	1.313	1.406	1.500

NET SECTION IN SQ. IN. OF ONE ANGLE DEDUCTING ONE 3/4" HOLE

Thickness.	1/4	5/16	3/8	7/16	1/2	9/16	5/8	11/16	3/4	13/16	7/8	15/16	1
Deducted.	.19	.23	.28	.33	.38	.42	.47	.52	.56	.61	.66	.70	.75
8×8	. .	. .	. .	. .	7.37	8.26	9.14	10.01	10.88	11.73	12.57	13.42	14.25
7×3½	. .	. .	. .	4.07	4.62	5.17	5.70	6.23	6.75	7.26	7.76	8.27	8.75
6×6	. .	. .	4.08	4.73	5.37	6.01	6.64	7.26	7.88	8.48	9.08	9.67	10.25
6×4	. .	. .	3.33	3.85	4.37	4.89	5.39	5.89	6.38	6.86	7.33	7.80	8.25
5×3½	. .	2.33	2.77	3.20	3.62	4.05	4.45	4.85	5.25	5.64	6.01		
4×4	. .	2.17	2.58	2.98	3.37	3.76	4.14	4.51	4.88	5.23			
4 ×3	. .	1.86	2.20	2.54	2.87	3.20	3.51	3.82	4.13	4.42			
3 ×3	1.25	1.55	1.83	2.10	2.37	2.64	2.89						
3 ×2½	1.12	1.39	1.64	1.89	2.12	2.36							
2½×2½	1.00	1.24	1.45	1.67	1.87								
2½×2	.87	1.08	1.27	1.45	1.62								
2 ×2	.75	.92	1.08	1.23									

NET SECTION IN SQ. IN. OF ONE ANGLE DEDUCTING TWO 3/4" HOLES

Thickness.	1/4	5/16	3/8	7/16	1/2	9/16	5/8	11/16	3/4	13/16	7/8	15/16	1
Deducted.	.38	.47	.56	.66	.75	.84	.94	1.03	1.13	1.22	1.31	1.41	1.50
8×8	. .	. .	. .	. .	7.00	7.84	8.67	9.50	10.31	11.12	11.92	12.71	13.50
7×3½	. .	. .	. .	3.74	4.25	4.75	5.23	5.72	6.18	6.65	7.11	7.56	8.00
6×6	. .	. .	3.80	4.40	5.00	5.59	6.17	6.75	7.31	7.87	8.43	8.96	9.50
6×4	. .	. .	3.05	3.52	4.00	4.47	4.92	5.38	5.81	6.25	6.68	7.09	7.50
5×3½	. .	2.09	2.49	2.87	3.25	3.63	3.98	4.34	4.68	5.03	5.36		
4×4	. .	1.93	2.30	2.65	3.00	3.34	3.67	4.00	4.31	4.62			
4 ×3	. .	1.62	1.92	2.21	2.50	2.78	3.04	3.31	3.56	3.81			
3 ×3	1.06	1.31	1.55	1.77	2.00	2.22	2.42						
3 ×2½	.93	1.15	1.36	1.56	1.75	1.94							
2½×2½	.81	1.00	1.17	1.34	1.50								
2½×2	.68	.84	.99	1.12	1.25								
2 ×2	.56	.68	.80	.90									

NET SECTION IN SQ. IN. OF ONE ANGLE DEDUCTING THREE 3/4" HOLES

Thickness.	3/8	7/16	1/2	9/16	5/8	11/16	3/4	13/16	7/8	15/16	1
Deducted.	.84	.98	1.13	1.27	1.41	1.55	1.69	1.83	1.97	2.12	2.25
8×8		. . .	6.62	7.41	8.20	8.98	9.75	10.51	11.26	12.01	12.75
6×6	3.52	4.08	4.62	5.16	5.70	6.23	6.75	7.26	7.77	8.26	8.75

TABLE 42

NET SECTION IN SQ. IN. OF ONE ANGLE DEDUCTING ONE $\frac{7}{8}''$ HOLE

THICKNESS.	$\frac{1}{4}$	$\frac{5}{16}$	$\frac{3}{8}$	$\frac{7}{16}$	$\frac{1}{2}$	$\frac{9}{16}$	$\frac{5}{8}$	$\frac{11}{16}$	$\frac{3}{4}$	$\frac{13}{16}$	$\frac{7}{8}$	$\frac{15}{16}$	1
DEDUCTED.	.22	.27	.33	.38	.44	.49	.55	.60	.66	.71	.77	.82	.88
8×8	. .	. .	. .	. .	7.31	8.19	9.06	9.93	10.78	11.63	12.46	13.30	14.12
7×3½	. .	. .	. .	4.02	4.56	5.10	5.62	6.15	6.65	7.16	7.65	8.15	8.62
6×6	. .	. .	4.03	4.68	5.31	5.94	6.56	7.18	7.78	8.38	8.97	9.55	10.12
6×4	. .	. .	3.28	3.80	4.31	4.82	5.31	5.81	6.28	6.76	7.22	7.68	8.12
5×3½	. .	2.29	2.72	3.15	3.56	3.98	4.37	4.77	5.15	5.54	5.90		
4×4	. .	2.13	2.53	2.93	3.31	3.69	4.06	4.43	4.78	5.13			
4 ×3	. .	1.82	2.15	2.49	2.81	3.13	3.43	3.74	4.03	4.32			
3 ×3	1.22	1.51	1.78	2.05	2.31	2.57	2.81						
3 ×2½	1.09	1.35	1.59	1.84	2.06	2.29							
2½×2½	.97	1.20	1.40	1.62	1.81								
2½×2	.84	1.04	1.22	1.40	1.56								
2 ×2	.72	.88	1.03	1.18									

NET SECTION IN SQ. IN. OF ONE ANGLE DEDUCTING TWO $\frac{7}{8}''$ HOLES

THICKNESS.	$\frac{1}{4}$	$\frac{5}{16}$	$\frac{3}{8}$	$\frac{7}{16}$	$\frac{1}{2}$	$\frac{9}{16}$	$\frac{5}{8}$	$\frac{11}{16}$	$\frac{3}{4}$	$\frac{13}{16}$	$\frac{7}{8}$	$\frac{15}{16}$	1
DEDUCTED.	.44	.55	.66	.77	.88	.98	1.09	1.20	1.31	1.42	1.53	1.64	1.75
8×8	. .	. .	. .	. .	6.87	7.70	8.52	9.33	10.13	10.92	11.70	12.48	13.25
7×3½	. .	. .	. .	3.63	4.12	4.61	5.08	5.55	6.00	6.45	6.89	7.33	7.75
6×6	. .	. .	3.70	4.29	4.87	5.45	6.02	6.58	7.13	7.67	8.21	8.73	9.25
6×4	. .	. .	2.95	3.41	3.87	4.33	4.77	5.21	5.63	6.05	6.46	6.86	7.25
5×3½	. .	2.01	2.39	2.76	3.12	3.49	3.83	4.17	4.50	4.83	5.14		
4×4	. .	1.85	2.20	2.54	2.87	3.20	3.52	3.83	4.13	4.42			
4 ×3	. .	1.54	1.82	2.10	2.37	2.64	2.89	3.14	3.38	3.61			
3 ×3	1.00	1.23	1.45	1.66	1.87	2.08	2.27						
3 ×2½	.87	1.07	1.26	1.45	1.62	1.80							
2½×2½	.75	.92	1.07	1.23	1.37								
2½×2	.62	.76	.89	1.01	1.12								
2 ×2	.50	.60	.70	.79									

NET SECTION IN SQ. IN. OF ONE ANGLE DEDUCTING THREE $\frac{7}{8}''$ HOLES

THICKNESS.	$\frac{3}{8}$	$\frac{7}{16}$	$\frac{1}{2}$	$\frac{9}{16}$	$\frac{5}{8}$	$\frac{11}{16}$	$\frac{3}{4}$	$\frac{13}{16}$	$\frac{7}{8}$	$\frac{15}{16}$	1
DEDUCTED.	.98	1.15	1.31	1.48	1.64	1.80	1.97	2.13	2.30	2.46	2.63
8×8	. . .	. . .	6.44	7.20	7.97	8.73	9.47	10.21	10.93	11.66	12.37
6×6	3.38	3.91	4.44	4.95	5.47	5.98	6.47	6.96	7.44	7.91	8.37

NET SECTION IN SQ. IN. OF ONE ANGLE DEDUCTING ONE 1" HOLE

Thickness	1/4	5/16	3/8	7/16	1/2	9/16	5/8	11/16	3/4	13/16	7/8	15/16	1
Deducted.	.25	.31	.38	.44	.50	.56	.63	.69	.75	.81	.88	.94	1.00
8×8	. .	. .	. .	. .	7.25	8.12	8.98	9.84	10.69	11.53	12.35	13.18	14.00
7×3½	. .	. .	. .	3.96	4.50	5.03	5.54	6.06	6.56	7.06	7.54	8.03	8.50
6×6	. .	. .	3.98	4.62	5.25	5.87	6.48	7.09	7.69	8.28	8.86	9.43	10.00
6×4	. .	. .	3.23	3.74	4.25	4.75	5.23	5.72	6.19	6.66	7.11	7.56	8.00
5×3½	. .	2.25	2.67	3.09	3.50	3.91	4.29	4.68	5.06	5.44	5.79		
4×4	. .	2.09	2.48	2.87	3.25	3.62	3.98	4.34	4.69	5.03			
4 ×3	. .	1.78	2.10	2.43	2.75	3.06	3.35	3.65	3.94	4.22			
3 ×3	1.19	1.47	1.73	1.99	2.25	2.50	2.73						
3 ×2½	1.06	1.31	1.54	1.78	2.00	2.22							
2½×2½	.94	1.16	1.35	1.56	1.75								
2½×2	.81	1.00	1.17	1.34	1.50								
2 ×2	.69	.84	.98	1.12									

NET SECTION IN SQ. IN. OF ONE ANGLE DEDUCTING TWO 1" HOLES

Thickness	1/4	5/16	3/8	7/16	1/2	9/16	5/8	11/16	3/4	13/16	7/8	15/16	1
Deducted.	.50	.63	.75	.88	1.00	1.13	1.25	1.38	1.50	1.63	1.75	1.88	2.00
8×8	. .	. .	. .	. .	6.75	7.55	8.36	9.15	9.94	10.71	11.48	12.24	13.00
7×3½	. .	. .	. .	3.52	4.00	4.46	4.92	5.37	5.81	6.24	6.67	7.09	7.50
6×6	. .	. .	3.61	4.18	4.75	5.30	5.86	6.40	6.94	7.46	7.99	8.49	9.00
6×4	. .	. .	2.86	3.30	3.75	4.18	4.61	5.03	5.44	5.84	6.24	6.62	7.00
5×3½	. .	1.93	2.30	2.65	3.00	3.34	3.67	3.99	4.31	4.62	4.92		
4×4	. .	1.77	2.11	2.43	2.75	3.05	3.36	3.65	3.94	4.21			
4 ×3	. .	1.46	1.73	1.99	2.25	2.49	2.73	2.96	3.19	3.40			
3 ×3	.94	1.15	1.36	1.55	1.75	1.93	2.11						
3 ×2½	.81	.99	1.17	1.34	1.50	1.65							
2½×2½	.69	.84	.98	1.12	1.25								
2½×2	.56	.68	.80	.90	1.00								
2 ×2	.44	.52	.61	.68									

NET SECTION IN SQ. IN. OF ONE ANGLE DEDUCTING THREE 1" HOLES

Thickness	3/8	7/16	1/2	9/16	5/8	11/16	3/4	13/16	7/8	15/16	1
Deducted.	1.13	1.31	1.50	1.69	1.88	2.06	2.25	2.44	2.63	2.81	3.00
8×8	. . .	. . .	6.25	6.99	7.73	8.47	9.19	9.90	10.60	11.31	12.00
6×6	3.23	3.75	4.25	4.74	5.23	5.72	6.19	6.65	7.11	7.56	8.00

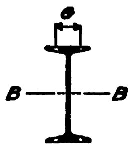


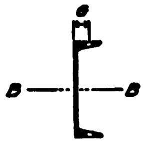
TABLE 44

NET VALUES OF BEAMS. ABOUT AXIS BB

Deducting one hole in top flange and one hole in bottom flange, using standard gauge and maximum size rivet

Beam. Depth.	Beam. Weight.	Diameter of Rivet.	Diameter of Holes.	Deduct for Holes. I	Deduct for Holes. C	Deduct for Holes. S	Net Values of Beam. I	Net Values of Beam. C	Net Values of Beam. S
24	100	7/8	1	226.3	201200	18.9	2154.0	1914600	179.5
"	95	"	"	"	"	"	2083.3	1851700	173.6
"	90	"	"	"	"	"	2012.8	1789100	167.7
"	85	"	"	"	"	"	1942.3	1726400	161.8
"	80	"	"	"	"	"	1861.6	1654700	155.1
20	100	7/8	1	165.3	176200	16.5	1490.5	1589900	149.1
"	95	"	"	"	"	"	1441.5	1537700	144.2
"	90	"	"	"	"	"	1392.5	1485400	139.3
"	85	"	"	"	"	"	1343.4	1433100	134.4
"	80	"	"	"	"	"	1301.2	1388100	130.2
"	75	"	"	144.4	153900	14.4	1124.5	1199600	112.5
"	70	"	"	"	"	"	1075.5	1147300	107.6
"	65	"	"	"	"	"	1025.2	1093700	102.6
18	70	7/8	1	103.1	122100	11.5	818.2	969800	90.9
"	65	"	"	"	"	"	778.4	922700	86.4
"	60	"	"	"	"	"	738.7	875600	82.0
"	55	"	"	"	"	"	692.5	820900	76.9
15	75	3/4	7/8	71.5	101700	9.5	619.7	881300	82.7
"	70	"	"	"	"	"	592.1	842100	79.0
"	65	"	"	"	"	"	564.5	802900	75.3
"	60	"	"	"	"	"	537.5	764400	71.7
"	55	"	"	56.6	80400	7.5	454.4	646400	60.6
"	50	"	"	"	"	"	426.8	607100	57.0
"	45	"	"	"	"	"	399.2	567800	53.3
"	42	"	"	"	"	"	385.1	547900	51.4

Beam. Depth.	Beam. Weight.	Diameter of Rivet.	Diameter of Holes.	Deduct for Holes. I	Deduct for Holes. C	Deduct for Holes. S	Net Values of Beam. I	Net Values of Beam. C	Net Values of Beam. S
12	55	3/4	7/8	37.0	65800	6.2	284.0	504800	47.3
"	50	"	"	"	"	"	266.3	473400	44.4
"	45	"	"	"	"	"	248.7	442100	41.4
"	40	"	"	"	"	"	231.9	412300	36.6
"	35	"	"	30.6	54400	5.1	197.7	351400	32.9
"	31½	"	"	"	"	"	185.2	329300	30.9
10	40	3/4	7/8	18.6	39700	3.7	140.1	298800	28.0
"	35	"	"	"	"	"	127.8	272700	25.6
"	30	"	"	"	"	"	115.6	246600	23.1
"	25	"	"	"	"	"	103.5	220800	20.7
9	35	3/4	7/8	14.0	33300	3.1	97.8	231700	21.7
"	30	"	"	"	"	"	87.9	208200	19.5
"	25	"	"	"	"	"	77.9	184600	17.3
"	21	"	"	"	"	"	70.9	168000	15.8
8	25½	3/4	7/8	10.3	27400	2.6	58.1	155100	14.5
"	23	"	"	"	"	"	54.2	144600	13.5
"	20½	"	"	"	"	"	50.3	134200	12.5
"	18	"	"	"	"	"	46.6	124300	11.6
7	20	5/8	3/4	6.2	18800	1.8	36.0	109800	10.3
"	17½	"	"	"	"	"	33.0	100600	9.4
"	15	"	"	"	"	"	30.0	91600	8.6
6	17¼	5/8	3/4	4.1	14700	1.4	22.1	78400	7.3
"	14¾	"	"	"	"	"	19.9	70600	6.6
"	12¼	"	"	"	"	"	17.7	62800	5.9

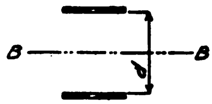


NET VALUES OF CHANNELS. ABOUT AXIS BB

Deducting one hole in top flange and one hole in bottom flange, using standard gauge and maximum size rivet

Channel.		Diam. of Rivet.	Diam. of Holes.	Deduct for Holes.			Net Values of Channel		
Depth.	Weight.			I	C	S	I	C	S
15	55	3/4	7/8	56.6	80400	7.5	373.6	531500	49.9
"	50	"	"	"	"	"	346.1	492300	46.2
"	45	"	"	"	"	"	318.5	453100	42.5
"	40	"	"	59.1	84100	7.9	288.4	410100	38.4
"	35	"	"	"	"	"	260.9	370900	34.8
"	33	"	"	"	"	"	253.5	360400	33.8
12	40	3/4	7/8	27.3	48500	4.5	169.7	301700	28.3
"	35	"	"	"	"	"	152.0	270300	25.4
"	30	"	"	"	"	"	134.4	238900	22.4
"	25	"	"	"	"	"	116.7	207600	19.5
"	20.50	"	"	"	"	"	100.8	179300	16.9
10	25	3/4	7/8	15.2	32400	3.0	75.8	161700	15.2
"	20	"	"	17.5	37300	3.5	61.2	130700	12.2
"	15	"	"	"	"	"	49.4	105400	9.9
9	20	3/4	7/8	12.2	28900	2.7	48.6	115200	10.8
"	15	"	"	13.1	31100	2.9	37.8	89400	8.4
"	13.25	"	"	"	"	"	34.2	81100	7.6
8	16.25	3/4	7/8	9.5	25400	2.4	30.4	81000	7.6
"	13.75	"	"	"	"	"	26.5	70600	6.6
"	11.25	"	"	"	"	"	22.8	60700	5.7
7	14.75	5/8	3/4	5.7	17400	1.6	21.5	65400	6.2
"	12.25	"	"	"	"	"	18.5	56300	5.3
"	9.75	"	"	"	"	"	15.4	49400	4.4
6	13	5/8	3/4	4.1	14700	1.4	13.2	46900	4.4
"	10.50	"	"	"	"	"	11.0	39100	3.6
"	8	"	"	"	"	"	8.9	31500	2.9

TABLE 46



NET VALUES OF COVER PLATES

About axis BB. The value of *d* is such that the plates may be used as cover plates for beams and channels

d in Inches.	Size of Plates.	Diameter of Rivet.	Diameter of Holes.	Net Area of Plates.	Net Value of Plates. I	*d* in Inches.	Size of Plates.	Diameter of Rivet.	Diameter of Holes.	Net Area of Plates.	Net Value of Plates. I
24	8×1	7/8	1	14.00	2188.7	15	8×1	3/4	7/8	14.25	913.2
"	8×7/8	"	"	12.25	1895.8	"	8×7/8	"	"	12.47	786.4
"	8×3/4	"	"	10.50	1608.4	"	8×3/4	"	"	10.69	663.3
"	8×5/8	"	"	8.75	1326.8	"	8×5/8	"	"	8.91	543.9
"	8×1/2	"	"	7.00	1050.6	"	8×1/2	"	"	7.13	428.1
						"	8×3/8	"	"	5.34	315.9
24	7×1	7/8	1	12.00	1876.0						
"	7×7/8	"	"	10.50	1624.9	15	6×1	3/4	7/8	10.25	656.8
"	7×3/4	"	"	9.00	1378.6	"	6×7/8	"	"	8.97	565.6
"	7×5/8	"	"	7.50	1137.2	"	6×3/4	"	"	7.69	477.1
"	7×1/2	"	"	6.00	900.5	"	6×5/8	"	"	6.41	391.2
						"	6×1/2	"	"	5.13	307.9
20	8×1	7/8	1	14.00	1544.7	"	6×3/8	"	"	3.84	227.2
"	8×7/8	"	"	12.25	1335.3						
"	8×3/4	"	"	10.50	1130.7	12	8×3/4	3/4	7/8	10.69	434.8
"	8×5/8	"	"	8.75	930.8	"	8×5/8	"	"	8.91	355.2
"	8×1/2	"	"	7.00	735.6	"	8×1/2	"	"	7.13	278.5
						"	8×3/8	"	"	5.34	204.6
20	6×1	7/8	1	10.00	1103.3	"	8×1/4	"	"	3.56	133.7
"	6×7/8	"	"	8.75	953.8						
"	6×3/4	"	"	7.50	807.6	12	6×3/4	3/4	7/8	7.69	312.8
"	6×5/8	"	"	6.25	664.9	"	6×5/8	"	"	6.41	255.5
"	6×1/2	"	"	5.00	525.4	"	6×1/2	"	"	5.13	200.3
						"	6×3/8	"	"	3.84	147.2
18	8×1	7/8	1	14.00	1264.7	"	6×1/4	"	"	2.56	96.1
"	8×7/8	"	"	12.25	1091.8						
"	8×3/4	"	"	10.50	923.3	10	6×5/8	3/4	7/8	6.41	181.0
"	8×5/8	"	"	8.75	759.1	"	6×1/2	"	"	5.13	141.4
"	8×1/2	"	"	7.00	599.1	"	6×3/8	"	"	3.84	103.5
						"	6×1/4	"	"	2.56	67.3
18	6×1	7/8	1	10.00	903.3						
"	6×7/8	"	"	8.75	779.9	9	6×5/8	3/4	7/8	6.41	148.6
"	6×3/4	"	"	7.50	659.5	"	6×1/2	"	"	5.13	115.7
"	6×5/8	"	"	6.25	542.2	"	6×3/8	"	"	3.84	84.5
"	6×1/2	"	"	5.00	427.9	"	6×1/4	"	"	2.56	54.8

PLATE GIRDERS

GRAPHIC IN DESIGN OF PLATE GIRDERS

Uniform loading. — The equation for bending moment in inch-pounds for uniform loading is, —

(*a*) $B = \frac{3}{2} wL^2 - 6 wx^2$,*

where B = bending moment in inch-pounds,

w = load in pounds per lineal foot of girder, including weight of girder,

L = span in feet,

x = distance in feet of section of moments from center of girder.

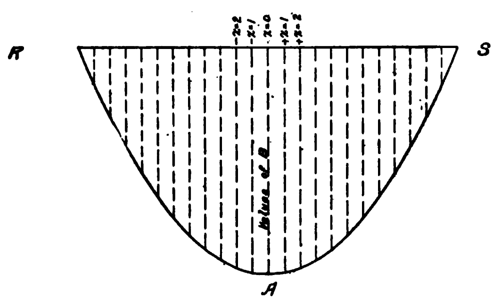


Fig. 1.

Equation (*a*) is a parabola and represents a curve of the form *RAS*, Fig. 1. Such a curve may be made the basis of graphical design, if vertical distances from the curve to the line *RS* represent bending moments for that point in the span.

The equation for moment of resistance is, —

(*b*) $M_r = \frac{RI}{e}$,

where M_r = moment of resistance,

R = safe extreme fiber stress in pounds per sq. in.,

I = moment of inertia,

e = distance in inches of extreme fiber from neutral axis.

---

* Equation (*a*) is usually written

$$(a')\ B = \frac{wL^2}{8} - \frac{wx^2}{2},$$

Where B = bending moment in foot-pounds.

The values of the other terms are the same as in equation (*a*). Reducing the bending moment to inch-pounds by multiplying equation (*a'*) by 12 gives equation (*a*).

Where the value of $x = 0$ at the center of the span, equation (*a'*) becomes $B = \frac{wL^2}{8}$, or reducing this value to inch-pounds, $B = \frac{3}{2} wL^2$.

From equation (*b*), *R* and *e* being constants, *I* varies directly as M_r. It is then at once possible from a moment diagram such as Fig. 1 exhibits to scale the values of *I* by changing the scale of the figure by the proper ratio of multiplication.

To make an application of the above to a particular loading and span, plot a curve similar to *RAS*, Fig. 1, to any convenient scale, using the following values which are computed for a typical parabola.

Let $L = 24$ feet, $w = 20{,}000$ pounds,

then for $x =$ 0,	$B =$ 17,280,000
$x = \pm$ 1,	$B =$ 17,160,000
$\pm$ 2,	16,800,000
$\pm$ 3,	16,200,000
$\pm$ 4,	15,360,000
$\pm$ 5,	14,280,000
$\pm$ 6,	12,960,000
$\pm$ 7,	11,400,000
$\pm$ 8,	9,600,000
$\pm$ 9,	7,560,000
$\pm$ 10,	5,280,000
$\pm$ 11,	2 760,000
$\pm$ 12,	0

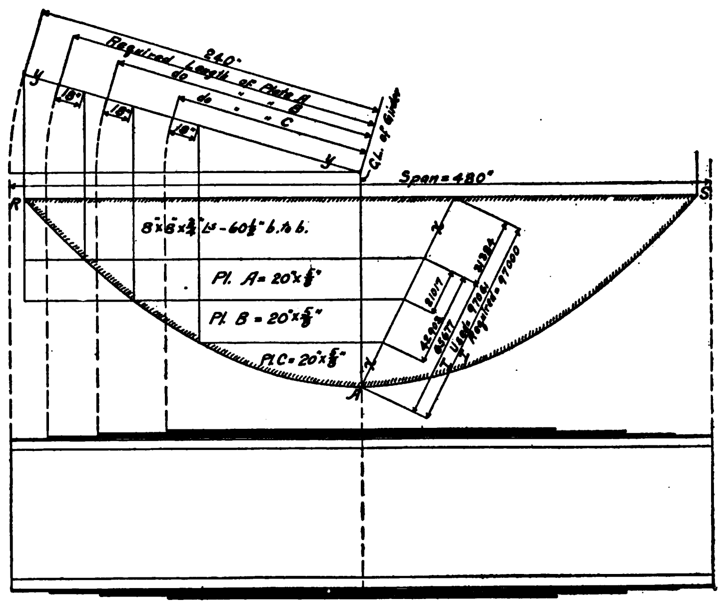


Fig. 2.

Compute the moment at the center of the span from equation (a) which for this point reduces to $B = \frac{1}{8}\,wL^2$. Conditions of design will give the depth of girder from which the value of e is obtained, whence $I = \frac{M_r\,e}{R}$ may be computed.

The curve, in connection with the tables for plate girders may now be made the basis of further determinations as follows, see Fig. 2. Draw the radial line xx representing I above determined, to a convenient scale. In a similar manner draw yy to represent half the span to a convenient scale. Proceed as in the following case in which the required moment of inertia at the center of the girder is 97,000, and the span 480 inches.

Uniform Loading

(1) Assume that no part of the web acts as flange, and a girder depth of 60½ inches back to back of flange angles. From table No. 49 the value of four 8 × 8 × ¾ angles, 60½ inches back to back, is 31,384, which leaves 65,616 to be provided for in cover plates. From table No. 51 for two 20-inch cover plates on angles 60½ inches back to back, the nearest value is 65,677 for two 1⅞ inch plates. This can be made up of six 20 × ⅝-inch plates, three on top and three on bottom. From the same table the value of two 20 × ⅝-inch plates is 21,017,* and two 20 × 1¼-inch plates is 42,903.

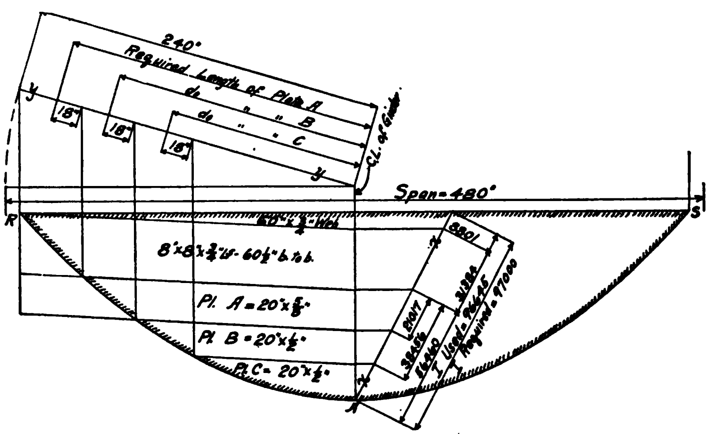


Fig. 3.

* It is seen from the tables that the value of two plates 1¼ inches thick is greater than twice the value of two ⅝-inch plates with the same distance back to back, since the value of e is greater for the thicker plates; the values should therefore be taken as the value of two plates of the total thickness of each flange plate.

Represent these values to scale on the line *xx* and draw lines parallel to *RS* until they intersect the curve *RAS*. From these points of intersection draw vertical lines to intersect *yy*, from which the length of the cover plates may be scaled. The cover plates shown in the figures are allowed to extend beyond this point 18 inches. This distance is an arbitrary figure, and will depend on the distance required to develop the plate, and the inclination of the curve. The web plate and stiffener angles are not considered in this example, as the tables give values for flanges only. The required girder is therefore made up of four angles, 8 × 8 × ¾, 60½ inches back to back, and six cover plates, 20 × ⅝ inches as flanges.

(2) Assume the same conditions as in example (1), except that ⅛ of the 60 × ¾ inch web plate is considered as flange. See Fig. 3. From table No. 47, the value of a 60 × ¾ inch plate with 8 × 8 inch flange angles is 8801; the value of four 8 × 8 × ¾ inch flange angles 60½ inches back to back is 31,384; as given in example (1), the re-

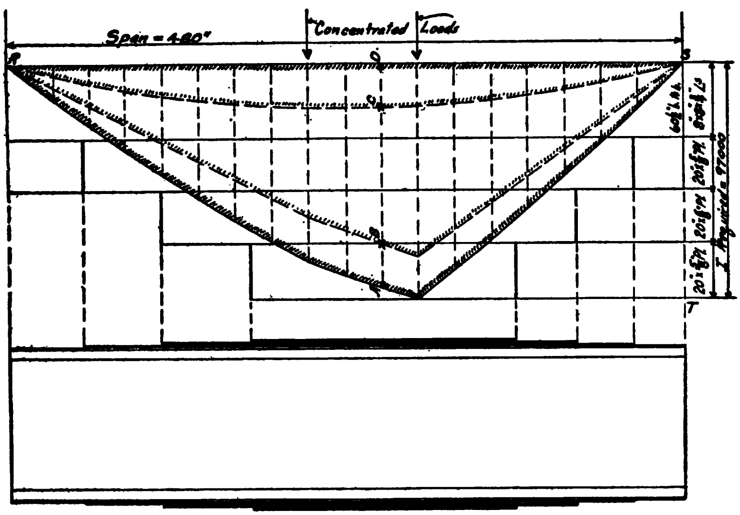


Fig. 4.

mainder of 56,460 is made up of cover plates in the same manner as in example (1). Lines are drawn from *xx* to "*CL* of Girder" parallel to *RS*; from this line all lines parallel to the line representing the value of the web until they intersect the curve *RAS*; the remainder of the operation is the same as in example (1).

Concentrated Loading

(3) Assume a girder of 480 inches span, supporting two concentrated loads, requiring a moment of inertia shown in Fig. 4 and bounded by the lines *RBS*. The uniform load diagram is bounded by the lines *RCS*. Combining these diagrams by adding the ordinates, for example, $AD = CD + BD$, the diagram *RAS* is obtained. By laying off to scale on a vertical line *ST* the values of flange angles and cover plates and drawing lines parallel to *RDS*, the length of the cover plates is determined as shown in the figure.

RESISTANCE OF WEB PLATE TO BENDING STRESS

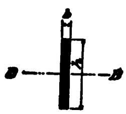


Fig. 5.

The general formula for moment of resistance is $M_r = RI \div e$. This equation becomes $M_r = RAh \div 6$ for the rectangle shown; where h = depth of web in inches and A = area of section in square inches $= bh$. Therefore the resistance of a web plate to bending is equivalent to a flange of $\frac{1}{6}$ of the area of the web concentrated at each edge of the web plate.

If it be assumed that an equivalent to $\frac{1}{4}$ of the web be cut away for rivets, the equation takes the form $M_r = RAh \div 8$, or its resistance is equivalent to a flange of $\frac{1}{8}$ of the area of the web concentrated at each edge of the web plate.

The assumption is made in the discussion above that there is no shearing stress in the web, and hence is only applicable at the center of plate girders carrying uniform loads where the web plate is fully spliced.

The following table, giving moment of inertia of web plates, is based on $\frac{1}{8}$ of the area of the web plate as effective flange at the center of gravity of each pair of flange angles.

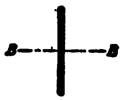


TABLE 47

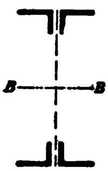
MOMENT OF INERTIA OF ONE WEB PLATE FOR PLATE GIRDERS

ABOUT AXIS BB

⅛ of area of web considered as effective flange at center of gravity of each pair of flange angles

Long leg of angles outstanding

Flange Angles.		Thickness of Web in Inches.											Depth of Web.
Size.	Back to Back.	¼	5/16	⅜	7/16	½	9/16	⅝	11/16	¾	⅞	1	
4×3×7/16	18¼	78	97	117	136	156	175	195	214	234	273	312	18
"	24¼	192	240	289	337	385	433	481	529	577	673	770	24
"	30¼	385	481	577	673	770	866	962	1058	1154	1347	1539	30
"	36¼	675	844	1013	1182	1351	1520	1688	1857	2026	2364	2701	36
5×3½×7/16	18¼	76	96	115	134	153	172	191	210	229	268	306	18
"	24¼	190	237	285	332	379	427	474	522	569	664	759	24
"	30¼	380	476	571	666	761	856	951	1046	1141	1332	1522	30
"	36¼	669	836	1004	1171	1338	1506	1673	1840	2007	2342	2677	36
"	42½	1089	1362	1634	1906	2178	2451	2723	2995	3268	3812	4357	42
6×4×½	24¼	186	232	279	325	372	418	465	511	558	651	744	24
"	30¼	375	468	562	656	749	843	937	1030	1124	1311	1498	30
"	36¼	661	826	991	1156	1321	1486	1652	1817	1982	2312	2642	36
"	42½	1077	1347	1616	1886	2155	2424	2694	2963	3232	3771	4310	42
"	48½	1623	2029	2435	2840	3246	3652	4058	4463	4869	5681	6492	48
6×6×9/16	24¼	163	203	244	285	325	366	407	447	488	569	651	24
"	30¼	337	422	506	591	675	759	844	928	1012	1181	1350	30
"	36¼	606	758	909	1061	1213	1364	1516	1667	1819	2122	2425	36
"	42½	1002	1253	1503	1754	2005	2255	2506	2756	3007	3508	4009	42
"	48½	1524	1905	2286	2667	3048	3429	3810	4191	4572	5335	6097	48
"	54½	2201	2752	3302	3853	4403	4953	5504	6054	6604	7705	8806	54
"	60½	3054	3818	4582	5345	6109	6873	7636	8400	9163	10691	12218	60
"	72½	5369	6711	8053	9395	10737	12079	13421	14764	16106	18790	21474	72
8×8×¾	42½	945	1181	1417	1653	1889	2125	2362	2598	2834	3306	3779	42
"	48½	1448	1810	2172	2534	2896	3258	3620	3982	4344	5068	5792	48
"	54½	2104	2630	3156	3683	4209	4735	5261	5787	6313	7365	8417	54
"	60½	2934	3667	4401	5134	5867	6601	7334	8068	8801	10268	11735	60
"	72½	5193	6491	7789	9087	10386	11684	12982	14280	15578	18175	20771	72



MOMENT OF INERTIA OF FOUR ANGLES

ABOUT AXIS BB DEDUCTING ONE HOLE FROM EACH ANGLE

One ⅞″ hole deducted for angles less than ⅝″ thick
One 1″ hole deducted for angles over 9/16″ thick
Long legs of angles outstanding

Size of Angles.	Total Section. Gross Weight.	Net Area.	Back to Back of Angles in Inches. 18¼	24¼	30¼	36¼	42½	48½	54½	60½	72½
4×3×5/16	28.4	7.28	516	947	1409	2202					
× 3/8	34.0	8.60	607	1115	1777	2595					
× 7/16	39.2	9.96	699	1286	2053	3098					
× 1/2	44.4	11.24	783	1444	2307	3372					
× 9/16	49.2	12.52	868	1602	2562	3747					
5×3½×5/16	34.8	9.16	640	1177	1880	2748	3827				
× 3/8	41.6	10.88	756	1393	2227	3256	4536				
× 7/16	48.0	12.60	871	1608	2571	3762	5243				
× 1/2	54.4	14.24	977	1807	2894	4236	5908				
× 9/16	60.8	15.92	1087	2013	3226	4725	6591				
× 5/8	67.2	17.16	1166	2162	3467	5081	7091				
6×4×3/8	49.2	13.12	. .	1661	2660	3894	5432	7148			
× 7/16	57.2	15.20	. .	1917	3072	4501	6280	8267			
× 1/2	64.8	17.24	. .	2163	3470	5087	7102	9352			
× 9/16	72.4	19.28	. .	2410	3869	5675	7926	10441			
× 5/8	80.0	20.92	. .	2605	4186	6144	8583	11309			
× 11/16	87.2	22.88	. .	2834	4559	6695	9359	12337			
× 3/4	94.4	24.76	. .	3055	4919	7228	10108	13327			
6×4 × 3/8 (Short leg outstanding)	49.2	13.12	. .	1415	2335	3491	4946	6584			
× 7/16	57.2	15.20	. .	1632	2696	4034	5718	7614			
× 1/2	64.8	17.24	. .	1840	3044	4558	6465	8612			
× 9/16	72.4	19.28	. .	2050	3393	4984	7214	9613			
× 5/8	80.0	20.92	. .	2216	3672	5504	7812	10413			
× 11/16	87.2	22.88	. .	2409	3897	5996	8517	11357			
× 3/4	94.4	24.76	. .	2596	4311	6472	9197	12268			
6×6 × 3/8	59.2	16.12	. .	1834	2993	4442	6261	8302	10634	13256	19371
× 7/16	68.8	18.72	. .	2121	3565	5146	7255	9624	12329	15372	22469
× 1/2	78.4	21.24	. .	2397	3919	5824	8214	10899	13967	17417	25463
× 9/16	87.6	23.76	. .	2666	4364	6490	9160	12160	15587	19442	28434
× 5/8	96.8	25.92	. .	2897	4747	7064	9973	13242	16978	21180	30984
× 11/16	106.0	28.36	. .	3157	5178	7709	10889	14462	18546	23140	33860
× 3/4	114.8	30.76	. .	3405	5951	8330	11773	15643	20067	25045	36661
8×8 × 1/2	105.6	29.24	. .	. .	. .	. .	10817	14424	18557	23217	34115
× 9/16	118.0	32.76	. .	. .	. .	. .	12093	16130	20757	25974	38176
× 5/8	130.8	35.92	. .	. .	. .	. .	13232	17655	22724	28439	41810
× 11/16	143.2	39.36	. .	. .	. .	. .	14468	19309	24859	31117	45759
× 3/4	155.6	42.76	. .	. .	. .	. .	15667	20918	26940	33731	49622
× 13/16	168.0	46.12	. .	. .	. .	. .	16861	22520	29009	36328	53457
× 7/8	180.0	49.40	. .	. .	. .	. .	18021	24076	31021	38855	57190
× 15/16	192.0	52.72	. .	. .	. .	. .	19189	25645	33051	41405	60959
× 1	204.0	56.00	. .	. .	. .	. .	20317	27165	35021	43884	64636

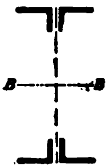
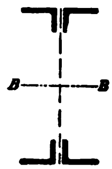


TABLE 49

MOMENT OF INERTIA OF FOUR ANGLES

ABOUT AXIS BB DEDUCTING TWO HOLES FOR EACH ANGLE
Two ⅞" holes deducted for angles less than ⅝" thick
Two 1" holes deducted for angles over 9/16" thick
Long legs of angles outstanding

Size of Angles.	Total Section. Gross Weight.	Net Area.	Back to Back of Angles in Inches. 18¼	24¼	30¼	36¼	42½	48½	54½	60½	72½
4×3 ×5/16	28.4	6.16	438	802	1278	1864					
×⅜	34.0	7.28	515	945	1506	2198					
×7/16	39.2	8.40	591	1086	1732	2530					
×½	44.4	9.48	662	1219	1947	2845					
×9/16	49.2	10.56	734	1353	2163	3162					
5×3½×5/16	34.8	8.04	563	1035	1653	2413	3360				
×⅜	41.6	9.56	666	1226	1958	2862	3987				
×7/16	48.0	11.04	765	1411	2255	3298	4595				
×½	54.4	12.48	858	1586	2538	3715	5179				
×9/16	60.8	13.96	955	1767	2831	4145	5782				
×⅝	67.2	14.68	1000	1853	2969	4350	6069				
6×4 ×⅜	49.2	11.80	. .	1496	2394	3504	4887	6431			
×7/16	57.2	13.64	. .	1623	2759	4041	5638	7421			
×½	64.8	15.48	. .	1944	3118	4570	6379	8400			
×9/16	72.4	17.32	. .	2167	3478	5101	7123	9382			
×⅝	80.0	18.44	. .	2300	3694	5419	7569	9972			
×11/16	87.2	20.12	. .	2496	4013	5892	8234	10852			
×¾	94.4	21.76	. .	2689	4327	6357	8887	11717			
Short leg outstanding. 6×4 ×⅜	49.2	11.80	. .	1278	2105	3145	4454	5927			
×7/16	57.2	13.64	. .	1471	2426	3626	5137	6839			
×½	64.8	15.48	. .	1660	2740	4100	5812	7740			
×9/16	72.4	17.32	. .	1849	3056	4575	6489	8644			
×⅝	80.0	18.44	. .	1963	3246	4861	6896	9189			
×11/16	87.2	20.12	. .	2130	3526	5284	7501	9998			
×¾	94.4	21.76	. .	2294	3801	5700	8095	10793			
6×6×⅜	59.2	14.80	. .	1689	2753	4084	5753	7627	9768	12176	17790
×7/16	68.8	17.16	. .	1950	3182	4723	6656	8828	11308	14097	20602
×½	78.4	19.48	. .	2205	3601	5348	7540	10003	12816	15980	23360
×9/16	87.6	21.80	. .	2453	4011	5962	8412	11164	14308	17845	26096
×⅝	96.8	23.44	. .	2629	4302	6397	9028	11984	15362	19163	28028
×11/16	106.0	25.60	. .	2860	4684	6969	9839	13065	16751	20898	30575
×¾	114.8	27.76	. .	3083	5056	7529	10636	14129	18121	22613	33097
8×8×½	105.6	27.48	. .	. .	. .	. .	10178	13567	17452	21831	32074
×9/16	118.0	30.80	. .	. .	. .	. .	11382	15178	19528	24433	35905
×⅝	130.8	33.44	. .	. .	. .	. .	12335	16452	21171	26492	38940
×11/16	143.2	36.60	. .	. .	. .	. .	13471	17973	23134	28953	42568
×¾	155.6	39.76	. .	. .	. .	. .	14587	19470	25069	31384	46160
×13/16	168.0	42.84	. .	. .	. .	. .	15683	20939	26967	33766	49676
×⅞	180.0	45.92	. .	. .	. .	. .	16774	22402	28858	36140	53183
×15/16	192.0	48.96	. .	. .	. .	. .	17845	23840	30717	38476	56636
×1	20.40	52.00	. .	. .	. .	. .	18892	25250	32545	40775	60044



MOMENT OF INERTIA OF FOUR ANGLES

ABOUT AXIS BB, DEDUCTING THREE HOLES FOR EACH ANGLE

Three ⅞″ holes deducted for angles less than ⅝″ thick
Three 1″ holes deducted for angles over $\frac{9}{16}$″ thick

Size of Angles.	Total Section.		Back to Back of Angles in Inches.							
	Gross Weight.	Net Area.	24¼	30¼	36¼	42½	48½	54½	60½	72½
6×6× ⅜	59.2	13.50	1546	2516	3730	5253	6963	8916	11112	16233
× $\frac{7}{16}$	68.8	15.65	1785	2908	4313	6077	8057	10319	12863	18795
× ½	78.4	17.75	2016	3288	4880	6878	9122	11685	14568	21292
× $\frac{9}{16}$	87.6	19.81	2237	3653	5426	7652	10153	13010	16224	23722
× ⅝	96.8	20.94	2359	3854	5725	8075	10716	13734	17129	25049
× $\frac{11}{16}$	106.0	22.87	2567	4196	6237	8801	11683	14976	18681	27326
× ¾	114.8	24.76	2762	4522	6727	9499	12614	16175	20182	29532
8×8× ½	105.6	25.75	. .	. .	. .	9549	12726	16366	20469	30067
× $\frac{9}{16}$	118.0	28.81	. .	. .	. .	10661	14211	18280	22868	33599
× ⅝	130.8	30.94	. .	. .	. .	11431	15240	19606	24529	36046
× $\frac{11}{16}$	143.2	33.87	. .	. .	. .	12486	16652	21427	26813	39412
× ¾	155.6	36.76	. .	. .	. .	13507	18022	23199	29037	42699
× $\frac{13}{16}$	168.0	39.61	. .	. .	. .	14523	19383	24956	31242	45953
× ⅞	180.0	42.42	. .	. .	. .	15519	20719	26683	33410	49154
× $\frac{15}{16}$	192.0	45.23	. .	. .	. .	16511	22050	28403	35570	52347
× 1	204.0	48.00	. .	. .	. .	17466	23335	30069	37666	55453

TABLE 51

MOMENT OF INERTIA OF

ABOUT AXIS BB, DEDUCTING

d = distance back to back of flange angles
A = net area of two plates
Two 7/8" holes deducted for plates less than 5/8" thick
" 1" " " " " over 9/16" thick
If 4 one-inch holes are deducted, use values of plates 2 inches less in width

Width of Plate in Inches.	Back to Back of Flange (d) in Inches.	Thickness of Plate in Inches. 1/4	5/16	3/8	7/16	1/2	9/16	5/8	11/16	3/4	13/16
9	**A =**	**3.63**	**4.53**	**5.44**	**6.34**	**7.25**	**8.16**	**8.75**	**9.63**	**10.50**	
9	18 1/4	310	390	472	554	637	722	780	863	948	
"	24 1/4	544	683	824	967	1110	1256	1354	1497	1641	
"	30 1/4	843	1058	1275	1494	1714	1936	2086	2304	2523	
10	**A =**	**4.13**	**5.56**	**6.19**	**7.22**	**8.25**	**9.28**	**10.00**	**11.00**	**12.00**	**13.00**
10	18 1/4	353	444	537	630	725	821	891	987	1084	1182
"	24 1/4	619	778	938	1100	1264	1429	1547	1711	1876	2042
"	30 1/4	959	1204	1451	1700	1950	2203	2384	2633	2884	3137
"	36 1/4	1374	1723	2075	2429	2786	3145	3400	3753	4108	4465
12	**A =**	**5.13**	**6.41**	**7.69**	**8.97**	**10.25**	**11.53**	**12.50**	**13.75**	**15.00**	**16.25**
12	24 1/4	769	966	1166	1367	1570	1775	1934	2138	2345	2553
"	30 1/4	1192	1496	1803	2112	2423	2737	2979	3291	3605	3921
"	36 1/4	1707	2141	2578	3018	3461	3907	4250	4691	5135	5581
"	42 1/2	2342	2936	3533	4134	4738	5346	5812	6412	7015	7622
"	48 1/2	3045	3816	4591	5370	6153	6940	7542	8317	9097	9880
14	**A =**	**6.13**	**7.66**	**9.19**	**10.72**	**12.25**	**13.78**	**15.00**	**16.50**	**18.00**	**19.50**
14	24 1/4	919	1155	1393	1633	1876	2122	2321	2566	2813	3063
"	30 1/4	1424	1788	2154	2524	2896	3271	3575	3949	4325	4705
"	36 1/4	2040	2559	3081	3607	4136	4669	5100	5629	6161	6698
"	42 1/2	2798	3508	4222	4941	5663	6389	6975	7695	8419	9147
"	48 1/2	3639	4561	5487	6418	7353	8294	9050	9981	10916	11856
"	54 1/2	4590	5751	6917	8088	9264	10446	11396	12564	13738	14916
"	60 1/2	5651	7079	8512	9951	11396	12847	14012	15444	16883	18327
16	**A =**	**7.13**	**8.91**	**10.69**	**12.47**	**14.25**	**16.03**	**17.50**	**19.25**	**21.00**	**22.75**
16	24 1/4	1069	1343	1620	1900	2183	2468	2708	2994	3282	3574
"	30 1/4	1657	2080	2506	2936	3369	3806	4171	4607	5046	5489
"	36 1/4	2373	2977	3584	4196	4812	5432	5950	6567	7188	7814
"	42 1/2	3255	4081	4912	5747	6587	7432	8137	8977	9822	10671
"	48 1/2	4233	5305	6383	7466	8554	9648	10559	11644	12735	13832
"	54 1/2	5339	6690	8046	9408	10777	12152	13295	14658	16027	17402
"	60 1/2	6574	8234	9901	11576	13256	14944	16347	18018	19697	21382
18	**A =**	**8.13**	**10.16**	**12.19**	**14.22**	**16.25**	**18.28**	**20.00**	**22.00**	**24.00**	**26.00**
18	36 1/4	2706	3394	4087	4785	5487	6194	6800	7505	8215	8930
"	42 1/2	3712	4654	5601	6554	7512	8476	9300	10259	11225	12195
"	48 1/2	4827	6050	7278	8513	9754	11002	12067	13308	14555	15808
"	54 1/2	6089	7628	9175	10729	12289	13857	15195	16752	18317	19888
"	60 1/2	7497	9390	11291	13200	15117	17042	18682	20592	22511	24437
"	72 1/2	10751	13461	16181	18911	21649	24397	26737	29461	32195	34937

TABLE 51 (Continued)

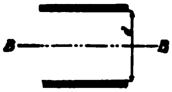
TWO COVER PLATES

TWO HOLES FROM EACH PLATE

d = distance back to back of flange angles
A = net area of two plates
Two $\frac{7}{8}''$ holes deducted for plates less than $\frac{5}{8}''$ thick
" 1" " " " " over $\frac{9}{16}''$ thick
If 4 one-inch holes are deducted, use values of plates 2 inches less in width

Thickness of Plate in Inches.										
$\frac{7}{8}$	$\frac{15}{16}$	1	$1\frac{1}{8}$	$1\frac{1}{4}$	$1\frac{3}{8}$	$1\frac{1}{2}$	$1\frac{5}{8}$	$1\frac{3}{4}$	$1\frac{7}{8}$	2
14.00	**15.00**	**16.00**								
1281	1382	1484								
2211	2380	2552								
3392	3649	3908								
4825	5187	5552								
17.50	**18.75**	**20.00**	**22.50**	**25.00**	**27.50**	**30.00**				
2763	2975	3190	3625	4068	4520	4980				
4240	4561	4885	5540	6205	6881	7567				
6031	6484	6940	7860	8793	9738	10695				
8232	8846	9463	10708	11967	13240	14527				
10667	11458	12253	13855	15473	17107	18757				
21.00	**22.50**	**24.00**	**27.00**	**30.00**	**33.00**	**36.00**	**39.00**	**42.00**	**45.00**	**48.00**
3316	3570	3828	4350	4881	5423	5975	6538	7111	7694	8287
5088	5473	5862	6648	7446	8257	9080	9916	10765	11626	12499
7237	7781	8328	9432	10551	11685	12833	13997	15173	16367	17575
9879	10615	11356	12850	14360	15887	17432	18993	20572	22168	23782
12800	13750	14704	16626	18568	20528	22508	24507	26526	28564	30622
16100	17289	18484	20889	23315	25763	28232	30723	33235	35769	38326
19778	21234	22696	25637	28603	31591	34604	37640	40701	43785	46894
24.50	**26.25**	**28.00**	**31.50**	**35.00**	**38.50**	**42.00**	**45.50**	**49.00**	**52.50**	**56.00**
3868	4165	4466	5074	5695	6327	6971	7627	8295	8976	9668
5935	6385	6839	7756	8687	9633	10594	11569	12558	13563	14582
8444	9077	9716	11004	12310	13632	14972	16329	17703	19095	20504
11525	12384	13248	14991	16753	18535	20337	22159	24001	25863	27745
14934	16041	17154	19397	21662	23949	26259	28591	30946	33324	35725
18783	20170	21564	24370	27201	30056	32937	35843	38774	41731	44713
23074	24772	26478	29910	33369	36856	40371	43913	47484	51082	54709
28.00	**30.00**	**32.00**	**36.00**	**40.00**	**44.00**	**48.00**	**52.00**	**56.00**	**60.00**	**64.00**
9650	10374	11103	12576	14068	15580	17111	18662	20232	21823	23433
13172	14154	15141	17133	19146	21183	23242	25324	27429	29557	31708
17067	18333	19605	22168	24756	27370	30010	32676	35367	38084	40828
21467	23052	24645	27852	31086	34350	37642	40963	44313	47692	51100
26370	28312	30261	34183	38136	42121	46138	50187	54267	58379	62524
37689	40450	43221	48790	54396	60040	65722	71442	77199	82994	88828

TABLE 51 (*Continued*)



MOMENT OF INERTIA OF

ABOUT AXIS BB, DEDUCTING

d = distance back to back of flange angles
A = net area of two plates
Two ⅞″ holes deducted for plates less than ⅝″ thick
" 1″ " " " " over 9/16″ thick
If 4 one-inch holes are deducted, use values of plates 2 inches less in width

Width of Plate in Inches.	Back to Back of Flanges in Inches.	Thickness of Plate in Inches. ¼	5/16	⅜	7/16	½	9/16	⅝	11/16	¾	13/16
20	**A =**	**9.13**	**11.41**	**13.69**	**15.97**	**18.25**	**20.53**	**22.50**	**24.75**	**27.00**	**29.25**
20	36¼	3039	3812	4590	5374	6162	6956	7649	8443	9242	10046
"	42½	4169	5227	6290	7360	8436	9519	10462	11542	12628	13720
"	48½	5422	6794	8174	9561	10955	12356	13575	14971	16374	17784
"	54½	6838	8567	10304	12049	13802	15563	17094	18846	20606	22374
"	60½	8419	10546	12681	14825	16977	19139	21017	23167	25324	27491
"	72½	12074	15118	18173	21238	24314	27400	30079	33144	36219	39304
22	**A =**	**10.13**	**12.66**	**15.19**	**17.72**	**20.25**	**22.78**	**25.00**	**27.50**	**30.00**	**32.50**
22	36¼	3372	4230	5093	5963	6838	7719	8499	9381	10269	1163
"	42½	4626	5800	6980	8167	9361	10562	11624	12824	14031	15244
"	48½	6016	7539	9070	10609	12156	13710	15084	16635	18193	19760
"	54½	7588	9506	11434	13370	15315	17268	18993	20940	22896	24860
"	60½	9342	11701	14071	16449	18838	21236	23353	25741	28138	30546
"	72½	13397	16775	20165	23566	26979	30403	33421	36827	40243	43672
24	**A =**	**11.13**	**13.91**	**16.69**	**19.47**	**22.25**	**25.03**	**27.50**	**30.25**	**33.00**	**35.75**
24	36¼	3705	4648	5596	6551	7513	8481	9349	10319	11296	12279
"	42½	5083	6372	7669	8974	10286	11605	12787	14107	15434	16769
"	48½	6610	8284	9966	11657	13356	15064	16592	18298	20013	21736
"	54½	8337	10445	12563	14690	16827	18974	20892	23034	25185	27346
"	60½	10264	12857	15460	18074	20699	23334	25688	38315	30952	33600
"	72½	14720	18432	22156	25893	29643	33406	36763	40509	44268	48039
26	**A =**							**30.00**	**33.00**	**36.00**	**39.00**
26	42½	. . .	. . .	. . .	. . .	. . .	. . .	13949	15389	16837	18293
"	48½	. . .	. . .	. . .	. . .	. . .	. . .	18101	19962	21832	23712
"	54½	. . .	. . .	. . .	. . .	. . .	. . .	22792	25128	27475	29832
"	60½	. . .	. . .	. . .	. . .	. . .	. . .	28023	30889	33766	36655
"	72½	. . .	. . .	. . .	. . .	. . .	. . .	40106	44192	48292	52406
28	**A =**							**32.50**	**35.75**	**39.00**	**42.25**
28	42½	. . .	. . .	. . .	. . .	. . .	. . .	15112	16671	18240	19817
"	48½	. . .	. . .	. . .	. . .	. . .	. . .	19609	21625	23651	25688
"	54½	. . .	. . .	. . .	. . .	. . .	. . .	24691	27222	29764	32318
"	60½	. . .	. . .	. . .	. . .	. . .	. . .	30358	33463	36580	39709
"	72½	. . .	. . .	. . .	. . .	. . .	. . .	43448	47874	52316	56773
32	**A =**							**37.50**	**41.25**	**45.00**	**48.75**
32	42½	. . .	. . .	. . .	. . .	. . .	. . .	17437	19236	21046	22866
"	48½	. . .	. . .	. . .	. . .	. . .	. . .	22626	24952	27290	29639
"	54½	. . .	. . .	. . .	. . .	. . .	. . .	28490	31410	34344	37290
"	60½	. . .	. . .	. . .	. . .	. . .	. . .	35029	38611	42207	45818
"	72½	. . .	. . .	. . .	. . .	. . .	. . .	50132	55240	60365	65507

TWO COVER PLATES

TWO HOLES FROM EACH PLATE

d = distance back to back of flange angles
A = net area of two plates
Two ⅞" holes deducted for plates less than ⅝" thick
" 1" " " " " over $\frac{9}{16}$" thick
If 4 one-inch holes are deducted use values of plates 2 inches less in width

Thickness of Plate in Inches.										
⅞	$\frac{15}{16}$	1	1⅛	1¼	1⅜	1½	1⅝	1¾	1⅞	2
31.50	**33.75**	**36.00**	**40.50**	**45.00**	**49.50**	**54.00**	**58.50**	**63.00**	**67.50**	**72.00**
10856	11671	12491	14148	15827	17527	19250	20994	22761	24550	26362
14818	15923	17034	19274	21540	23831	26147	28489	30857	33251	35671
19201	20625	22056	24939	27851	30792	33761	36760	39788	42845	45931
24150	25934	27726	31333	34972	38644	42347	46083	49852	53653	57487
29666	31851	34044	38456	42903	47387	51905	56460	61050	65677	70339
42400	45507	48624	54889	61196	67545	73937	80372	86849	93368	99931
35.00	**37.50**	**40.00**	**45.00**	**50.00**	**55.00**	**60.00**	**65.00**	**70.00**	**75.00**	**80.00**
12062	12968	13879	15720	17585	19475	21388	23327	25290	27278	29291
16465	17692	18926	21416	23933	26478	29052	31655	34286	36946	39634
21334	22916	24506	27710	30945	34213	37512	40844	44208	47605	51034
26833	28815	30806	34814	38858	42937	47052	51203	55391	59614	63874
32963	35390	37826	42729	47670	52652	57672	62733	67833	72974	78154
47111	50563	54026	60987	67995	75050	82152	89302	96498	103742	111034
38.50	**41.25**	**44.00**	**49.50**	**55.00**	**60.50**	**66.00**	**71.50**	**77.00**	**82.50**	**88.00**
13268	14265	15267	17292	19344	21422	23527	25659	27818	30005	32227
18111	19461	20819	23557	26326	29126	31958	34820	37714	40640	43605
23467	25208	26957	30481	34040	37634	41264	44928	48629	52337	56145
29517	31697	33887	38296	42744	47231	51758	56324	60930	65576	70269
36259	38929	41609	47001	52437	57917	63440	69006	74616	80271	85977
51823	55619	59429	67086	74795	82555	90368	98232	106148	114116	122145
42.00	**45.00**	**48.00**	**54.00**	**60.00**	**66.00**	**72.00**	**78.00**	**84.00**	**90.00**	**96.00**
19758	21230	22711	25699	28719	31774	34863	37985	41143	44334	47561
25601	27499	29407	33252	37134	41055	45015	49013	53050	57125	61241
32200	34578	36967	41777	46629	51525	56463	61444	66469	71537	76649
39555	42467	45391	51274	57204	63182	69207	75279	81400	87568	93785
56534	60676	64831	73185	81594	90060	98583	107162	115798	124490	133241
45.50	**48.75**	**52.00**	**58.50**	**65.00**	**71.50**	**78.00**	**84.50**	**91.00**	**97.50**	**104.00**
21404	22999	24604	27840	31113	34422	37768	41151	44571	48029	51524
27734	29791	31858	36023	40229	44476	48766	53097	57470	61886	66344
34883	37460	40048	45258	50515	55818	61168	66564	72007	77498	83036
42852	46006	49174	55548	61971	68447	74974	81552	88183	94865	101600
61245	65732	70234	79284	88394	97565	106798	116092	125447	134864	144344
52.50	**56.25**	**60.00**	**67.50**	**75.00**	**82.50**	**90.00**	**97.50**	**105.00**	**112.50**	**120.00**
24697	26538	28389	32123	35899	39717	43578	47481	51428	55417	59450
32001	34374	36759	41565	46418	51319	56268	61265	66311	71406	76550
40250	43223	46209	52221	58287	64405	70578	76805	83085	89420	95810
49444	53084	56739	64093	71505	78977	86508	94099	101749	109459	117230
70667	75844	81039	91481	101993	112575	123228	133952	144746	155613	166550

TIMBER COLUMNS, BEAMS, AND FLOORING

STRENGTH OF TIMBER

The following data on strength of timber, pages 110 to 114, are taken from the Report of a Committee of the American International Association of Railway Superintendents of Bridges and Buildings on "Strength of Bridge and Trestle Timbers." The report was made in 1895.

The test data at hand and the summary of criticisms of leading authorities seem to indicate the general correctness of the following conclusions:

(1) Of all structural materials used for bridges and trestles, timber is the most variable as to the properties and strength of the different pieces classed as belonging to the same species; hence it is impossible to establish close and reliable limits for each species.

(2) The various names applied to one and the same species in different parts of the country lead to great confusion in classifying or applying results of tests.

(3) Variations in strength are generally directly proportional to the density or weight of timber.

(4) As a rule, a reduction of moisture is accompanied by an increase in strength; in other words, seasoned lumber is stronger than green lumber.

(5) Structures should be, in general, designed for the strength of green or moderately seasoned lumber of average quality and not for a high grade of well-seasoned material.

(6) Age and use do not destroy the strength of timber unless decay or season checking takes place.

(7) Timber, unlike materials of a more homogeneous nature, as iron and steel, has no well-defined limit of elasticity. As a rule, it can be strained very near to the breaking point without serious injury, which accounts for the continuous use of many timber structures with the material strained far beyond the usually accepted safe limits. On the other hand, sudden and frequently inexplicable failures of individual sticks at very low limits are liable to occur.

(8) Knots, even when sound and tight, are one of the most objectionable features of timber, both for beams and struts. The full-size tests of every experimenter have demonstrated not only that beams break at knots, but that invariably timber struts will fail at a knot or owing to the proximity of a knot, by reducing the effective area of the stick and causing curly and cross-grained fibers, thus exploding the old practical view that sound and tight knots are not detrimental to timber in compression.

(9) Excepting in top logs of a tree or very small and young timber, the heart wood is, as a rule, not as strong as the material farther away from the heart. This becomes more generally apparent, in practice, in large sticks with considerable heart wood cut from old trees in which the heart has begun to decay or been wind shaken. Beams cut from such material frequently season check along middle of beam and fail by longitudinal shearing.

(10) Top logs are not as strong as butt logs, provided the latter have sound timber.

(11) The results of compression tests are more uniform and vary less for one species of timber than any other kind of test; hence, if only one kind of test can be made, it would seem that a compressive test will furnish the most reliable comparative results.

(12) Long timber columns generally fail by lateral deflection or "buckling" when the length exceeds the least cross-sectional dimensions of the stick by 20; in other words, when the column is longer than 20 diameters. In practice the unit stress for all columns over 15 diameters should be reduced in accordance with the various rules and formulæ established for long columns.

(13) Uneven end bearings and eccentric loading of columns produce more serious disturbances than are usually assumed.

(14) The tests of full-size long compound columns, composed of several sticks bolted and fastened together at intervals, show essentially the same ultimate unit resistance for the compound column as each component stick would have if considered as a column by itself.

(15) More attention should be given in practice to the proper proportioning of bearing areas; in other words, the compressive bearing resistance of timber with and across grain, especially the latter, owing to the tendency of an excessive crushing stress across grain to indent the timber, thereby destroying the fiber and increasing the liability to speedy decay, especially when exposed to the weather and the continual working produced by moving loads.

The aim of your committee has been to examine the conflicting test data at hand, attributing the proper degree of importance to the various results and recommendations, and then to establish a set of units that can be accepted as fair average values, as far as known to-day, for the ordinary quality of each species of timber and corresponding to the usual conditions and sizes of timbers encountered in practice. The difficulties of executing such a task successfully can not be overrated, owing to the meagerness and frequently the indefiniteness of the available test data, and especially the great range of physical properties in different sticks of the same general species, not only due to the locality where it is grown, but also to the condition of the timber as regards the percentage of moisture, degree of seasoning, physical characteristics, grain, texture, proportion of hard and soft fibers, presence of knots, etc., all of which affect the question of strength.

Your committee recommends, upon the basis of the test data at hand at the present time, the average units for the ultimate breaking stresses of the principal timbers used in bridge and trestle constructions shown in the accompanying table.

Attention should also be called to the necessity of examining the resistance of a beam to longitudinal shearing along the neutral axis, as beams under transverse loading frequently fail by longitudinal shearing in the place of transverse rupture.

In addition to the ultimate breaking unit stress the designer of a timber structure has to establish the safe allowable unit stress for the species of timber to be used. This will vary for each particular class of structures and individual conditions. The selection of the proper "factor of safety" is largely a question of personal judgment and experience, and offers the best opportunity for the display of analytical and practical ability on the part of the designer. It is difficult to give specific rules. The following are some of the controlling questions to be considered:

The class of structure, whether temporary or permanent, and the nature of the oading, whether dead or live: if live, then whether the application of the load is accompanied by severe dynamic shocks and pounding of the structure. Whether the assumed loading for calculations is the absolute maximum, rarely to be applied in practice, or a possibility that may frequently take place. Prolonged heavy, steady loading, and also alternate tensile and compressive stresses in the same place will call for lower averages. Information as to whether the assumed breaking stresses are based on full-size or small-size tests, or only on interpolated values, averaged from tests of similar species of timber, is valuable in order to attribute the proper degree of importance to recommended average values. The class of timber to be used and its condition and quality. Finally, the particular kind of strain the stick is to be subjected to and its position in the structure with regard to its importance and the possible damage that might be caused by its failure.

In order to present something definite on this subject, your committee presents the accompanying table, showing the average safe allowable working unit stresses for the principal bridge and trestle timbers, prepared to meet the average conditions existing in railroad timber structures, the units being based upon the ultimate breaking unit stresses recommended by your committee and the following factors of safety, viz.:

Tension with and across grain	10
Compression with grain	5
Compression across grain	4
Transverse rupture, extreme fiber stress	6
Transverse rupture, modulus of elasticity	2
Shearing with and across grain	4

TABLE 52

AVERAGE SAFE ALLOWABLE WORKING UNIT STRESSES IN POUNDS PER SQUARE INCH

RECOMMENDED BY THE COMMITTEE ON "STRENGTH OF BRIDGE AND TRESTLE TIMBERS," AMERICAN ASSOCIATION OF RAILWAY SUPERINTENDENTS OF BRIDGES AND BUILDINGS, FIFTH ANNUAL CONVENTION, NEW ORLEANS, OCTOBER, 1895

Kind of Timber.	Tension.		Compression.			Transverse Rupture.		Shearing.	
			With Grain.						
	With Grain.	Across Grain.	End Bearing.	Columns under 15 diameters.	Across Grain.	Extreme Fiber Stress.	Modulus of Elasticity.	With Grain.	Across Grain.
Factor of safety	10	10	5	5	4	6	2	4	4
White oak	1000	200	1400	900	500	1000	550000	200	1000
White pine	700	50	1100	700	200	700	500000	100	500
Southern, longleaf, or Georgia yellow pine	1200	60	1600	1000	350	1200	850000	150	1250
Douglas, Oregon, and Washington fir or pine:									
Yellow fir	1200	...	1600	1200	300	1100	700000	150	...
Red fir	1000	...	...	...	...	800	....	...	...
Northern or shortleaf yellow pine	900	50	1200	800	250	1000	600000	100	1000
Red pine	900	50	1200	800	200	800	600000	...	...
Norway pine	800	...	1200	800	200	700	600000	...	...
Canadian (Ottawa) white pine	1000	...	...	1000	...	...	....	100	...
Canadian (Ontario) red pine	1000	...	...	1000	...	800	700000	100	...
Spruce and Eastern fir	800	50	1200	800	200	700	600000	100	750
Hemlock	600	...	...	800	150	600	450000	100	600
Cypress	600	...	1200	800	200	800	450000	...	...
Cedar	800	...	1200	800	200	800	350000	...	400
Chestnut	900	...	...	1000	250	800	500000	150	400
California redwood	700	...	...	800	200	750	350000	100	...
California spruce	....	...	...	800	...	800	600000	...	...

TABLE 53

AVERAGE ULTIMATE BREAKING UNIT STRESSES IN POUNDS PER SQUARE INCH

RECOMMENDED BY THE COMMITTEE ON "STRENGTH OF BRIDGE AND TRESTLE TIMBERS," AMERICAN ASSOCIATION OF RAILWAY SUPERINTENDENTS OF BRIDGES AND BUILDINGS, FIFTH ANNUAL CONVENTION, NEW ORLEANS, OCTOBER, 1895

Kind of Timber.	Tension.		Compression.			Transverse Rupture.		Shearing.	
			With Grain.						
	With Grain.	Across Grain.	End Bearing.	Columns Under 15 Diameters.	Across Grain.	Extreme Fiber Stress.	Modulus of Elasticity.	With Grain.	Across Grain.
White oak	10000	2000	7000	4500	2000	6000	1100000	800	4000
White pine	7000	500	5500	3500	800	4000	1100000	400	2000
Southern longleaf, or Georgia yellow pine	12000	600	8000	5000	1400	7000	1700000	600	5000
Douglas, Oregon, and Washington fir or pine									
Yellow fir	12000	...	8000	6000	1200	6500	1400000	600	...
Red fir	10000	...	...	...	...	5000	.....	...	...
Northern or shortleaf yellow pine	9000	500	6000	4000	1000	6000	1200000	400	4000
Red pine	9000	500	6000	4000	800	5000	1200000	...	...
Norway pine	8000	...	6000	4000	800	4000	1200000	...	...
Canadian (Ottawa) white pine	10000	...	...	5000	...	...	.....	350	...
Canadian (Ontario) red pine	10000	...	...	5000	...	5000	1400000	400	...
Spruce and Eastern fir	8000	500	6000	4000	700	4000	1200000	400	3000
Hemlock	6000	...	...	4000	600	3500	900000	350	2500
Cypress	6000	...	6000	4000	700	5000	900000	...	...
Cedar	8000	...	6000	4000	700	5000	700000	...	1500
Chestnut	9000	...	...	5000	900	5000	1000000	600	1500
California redwood	7000	...	...	4000	800	4500	700000	400	...
California spruce	....	...	...	4000	...	5000	1200000	...	...

SAFE LOADS FOR WOOD COLUMNS

IN POUNDS PER SQUARE INCH OF CROSS-SECTION

The following safe loads are obtained from the formula

$$P = F\,\frac{700 + 15\,c}{700 + 15\,c + c^2},$$

where P = allowable working stress in lbs. per sq. in. for long columns.
F = allowable working stress in lbs. per sq. in. for short columns.
c = unbraced length in inches divided by least cross-sectional dimension in inches.

	Values of F.				
c	700	800	900	1000	1200
1	699	799	899	999	1198
2	696	796	895	995	1193
3	692	790	889	988	1186
4	686	783	881	979	1175
5	678	775	872	969	1162
6	669	765	861	956	1148
7	660	754	848	943	1131
8	649	742	835	928	1113
9	638	729	820	912	1094
10	626	716	805	895	1074
11	614	702	790	877	1053
12	602	688	773	859	1031
13	589	673	757	841	1009
14	576	658	741	823	987
15	563	644	724	804	965
16	550	629	707	786	943
17	537	614	691	768	921
18	525	600	675	750	900
19	512	585	659	732	878
20	500	571	643	714	857

	Values of F.				
c	700	800	900	1000	1200
21	488	558	627	697	837
22	476	544	612	680	816
23	465	531	598	664	797
24	454	518	583	648	777
25	443	506	569	632	759
26	432	494	555	617	741
27	422	482	542	603	723
28	412	471	529	588	706
29	402	460	517	574	689
30	393	449	505	561	673
32	375	428	482	535	642
34	358	409	460	511	614
36	342	391	440	489	587
38	328	374	421	468	561
40	314	359	403	448	538
42	301	344	387	430	516
44	289	330	371	413	495
46	278	317	357	397	476
48	267	305	343	381	458
50	257	294	330	367	441
60	215	246	277	308	369
70	184	211	237	263	316

Example 1. Required the size of a Southern Pine column capable of supporting a direct load of 40,000 pounds, the unbraced length of the column being 16 feet. *Solution:* Assuming an 8×8, $c = 192 \div 8 = 24$, $F = 1000$ for Southern Pine. From the above table for these values of c and F, $P = 648$. Let P' = load applied in pounds per square inch, A = area of cross-section of column in square inches, W = total load applied in pounds, then $P' = W \div A = 40{,}000 \div 64 = 625$. Since the load applied is less than the allowable load, the column is safe.

Example 2. Required the size of a Southern Pine column capable of supporting a load of 40,000 pounds, so applied as to produce a bending moment of 18,000 inch-pounds, the unbraced length of the column is 16 feet. *Solution:* Assuming an 8×10, $c = 24$, $F = 1000$, $P = 648$, $A = 80$. Placing the column so that the 10-inch dimension will be effective in resisting bending, $I = 667$, $e = 5$. Then $P' = \frac{W}{A} + \frac{Me}{I} = \frac{40{,}000}{80} + \frac{18{,}000 \times 5}{667} = 635$. Since P' is less than P, the column is safe.

TABLE 55

SAFE LOADS (UNIFORMLY DISTRIBUTED) FOR BEAMS 1″ THICK

Based on extreme fiber stress of **1000** pounds per square inch. The table is for total uniform loads in pounds, for beams one inch thick. The values are for an actual depth of $\frac{1}{4}$ inch less than the nominal depth, or a 4-inch beam is reduced to $3\frac{3}{4}$ inches deep.

Span in Feet.	Nominal Depth of Beam.													
	4	5	6	7	8	9	10	12	14	16	18	20	22	24
4	391	627	918	1265	1668	2127	2640	3835	5268	6891	8752	10835	13141	15668
5	313	501	735	1012	1334	1701	2112	3068	4201	5512	7000	8668	10512	12535
6	260	418	612	844	1112	1418	1760	2557	3512	4594	5834	7224	8760	10446
7	223	358	525	723	953	1215	1508	2191	3001	3937	5001	6191	7509	8953
8	195	313	459	633	834	1063	1320	1918	2634	3446	4375	5418	6570	7834
9	174	279	408	563	741	944	1173	1704	2341	3063	3889	4815	5840	6964
10	156	251	367	506	667	851	1056	1534	2100	2756	3500	4334	5256	6267
11	142	228	334	460	607	774	960	1394	1910	2505	3182	3940	4778	5698
12	130	209	306	422	556	709	880	1278	1756	2297	2917	3612	4380	5223
13	120	193	283	389	513	654	812	1180	1616	2120	2692	3333	4043	4821
14	112	179	262	362	477	608	754	1095	1500	1968	2500	3095	3754	4477
15	104	167	245	338	445	567	704	1023	1400	1838	2333	2889	3504	4178
16	98	157	230	316	417	532	660	959	1317	1723	2188	2709	3285	3917
17	. .	147	216	298	393	500	621	902	1236	1621	2059	2549	3092	3687
18	. .	139	204	281	371	472	587	852	1170	1531	1944	2408	2920	3482
19	. .	132	193	266	351	448	556	807	1106	1451	1842	2281	2767	3299
20	. .	125	184	253	334	425	528	767	1054	1378	1750	2167	2628	3134
21	. .	. .	175	241	318	405	503	730	1000	1312	1667	2063	2503	2984
22	. .	. .	167	230	303	387	480	697	955	1253	1591	1970	2389	2849
23	. .	. .	160	220	290	370	459	667	917	1198	1522	1884	2286	2724
24	. .	. .	153	211	278	354	440	639	878	1149	1458	1806	2190	2611
25	. .	. .	. .	203	267	340	423	614	840	1103	1400	1734	2102	2507
26	. .	. .	. .	195	257	327	406	590	808	1060	1346	1667	2022	2411
27	. .	. .	. .	187	247	315	391	568	780	1021	1296	1605	1947	2321
28	. .	. .	. .	181	238	304	377	548	750	984	1250	1548	1877	2238
29	. .	. .	. .	. .	230	293	364	529	724	950	1207	1494	1812	2164
30		. .	. .	. .	222	283	352	511	700	919	1167	1444	1752	2089

To obtain the safe load concentrated at the center of beam, divide the safe load given in the above table by two.

TABLE 56 (*Continued on p.* 118)

SAFE LOADS (UNIFORMLY DISTRIBUTED) FOR BEAMS

Based on an extreme fiber stress of 1000 pounds per square inch. The table is for total uniform loads in pounds, for beams of the sizes and spans given below. The values are for an actual depth of ½ inch less than the nominal depth, or a 4 inch beam is taken as actually 3½ inches deep.

h = depth of beam in inches
b = thickness of beam in inches
Span = simple span in feet

SPAN.	h: 4	6		8			10			12			
b	2	2	3	2	3	4	2	3	4	2	3	4	6
4	780	1840	2750	3340	5000	6670	5280	7920	10560	7670	11510	15340	23010
5	630	1470	2210	2670	4000	5340	4220	6340	8450	6140	9200	12270	18410
6	520	1220	1840	2220	3340	4450	3520	5280	7040	5110	7670	10230	15340
7	450	1050	1580	1910	2860	3810	3020	4520	6030	4380	6570	8760	13150
8	390	920	1380	1670	2500	3340	2640	3960	5280	3840	5750	7670	11510
9	350	820	1220	1480	2220	2960	2350	3520	4690	3410	5110	6820	10220
10	310	730	1100	1330	2000	2670	2110	3170	4220	3070	4600	6140	9200
11	280	670	1000	1210	1820	2430	1920	2880	3840	2790	4180	5580	8360
12	260	610	920	1110	1670	2220	1760	2640	3520	2560	3830	5110	7670
13	240	570	850	1030	1540	2050	1620	2440	3250	2360	3540	4720	7080
14	220	520	790	950	1430	1910	1510	2260	3020	2190	3290	4380	6570
15	210	490	740	890	1340	1780	1410	2110	2820	2050	3070	4090	6140
16	200	460	690	830	1250	1670	1320	1980	2640	1920	2880	3840	5750
17	...	430	650	790	1180	1570	1240	1860	2480	1800	2710	3610	5410
18	...	410	610	740	1110	1480	1170	1760	2350	1700	2560	3410	5110
19	...	390	580	700	1050	1400	1110	1670	2220	1610	2420	3230	4840
20	...	370	550	670	1000	1340	1060	1580	2110	1530	2300	3070	4600
21	...	350	530	640	950	1270	1010	1510	2010	1460	2190	2920	4380
22	...	330	500	610	910	1210	960	1440	1920	1390	2090	2790	4180
23	...	320	480	580	870	1160	920	1380	1840	1330	2000	2670	4000
24	...	310	460	560	830	1110	880	1320	1760	1280	1920	2560	3830
25	...	...	...	530	800	1070	850	1270	1690	1230	1840	2460	3680
26	...	...	...	510	770	1030	810	1220	1620	1180	1770	2360	3540
27	...	...	...	490	740	990	780	1170	1560	1140	1700	2270	3410
28	...	...	...	480	710	950	750	1130	1510	1100	1640	2190	3290
29	...	...	...	460	690	920	730	1090	1460	1060	1590	2120	3170
30	...	...	...	440	670	890	700	1060	1410	1020	1530	2040	3070

(See Note at foot of Table on page 118.)

TABLE 56 (*Continued*)

SAFE LOADS (UNIFORMLY DISTRIBUTED) FOR BEAMS

(See Note on page 117.)

Span.	h: 14				16				18			20	22	24
b	2	3	4	6	2	3	4	6	3	4	6	6	6	6
4	10540	15800	21070	31610	13780	20670	27560	41350	26260	35010	52510	65010	78850	94010
5	8400	12600	16800	25210	11020	16540	22050	33070	21000	28000	42000	52010	63070	75210
6	7020	10540	14050	21070	9190	13780	18380	27560	17500	23340	35000	43340	52560	62680
7	6000	9000	12000	18010	7870	11810	15750	23620	15000	20000	30010	37150	45050	53720
8	5270	7900	10540	15800	6890	10340	13780	20680	13130	17500	26250	32510	39420	47000
9	4680	7020	9360	14050	6130	9190	12250	18380	11670	15560	23330	28890	35040	41780
10	4200	6300	8400	12600	5510	8270	11020	16540	10500	14000	21000	26000	31540	37600
11	3820	5730	7640	11460	5010	7520	10020	15030	9550	12730	19090	23640	28670	34190
12	3510	5270	7020	10540	4590	6890	9190	13780	8750	11670	17500	21670	26280	31340
13	3230	4850	6460	9700	4240	6360	8480	12720	8080	10770	16150	20000	24260	28930
14	3000	4500	6000	9000	3940	5900	7870	11810	7500	10000	15000	18570	22520	26860
15	2800	4200	5600	8400	3680	5510	7350	11030	7000	9330	14000	17330	21020	25070
16	2630	3950	5270	7900	3450	5170	6890	10340	6560	8750	13130	16250	19710	23500
17	2470	3710	4940	7420	3240	4860	6480	9730	6180	8240	12350	15290	18550	22120
18	2340	3510	4680	7020	3060	4590	6120	9190	5830	7780	11660	14450	17520	20890
19	2210	3320	4420	6640	2900	4350	5800	8710	5530	7370	11050	13690	16600	19790
20	2110	3160	4220	6320	2760	4130	5510	8270	5250	7000	10500	13000	15770	18800
21	2000	3000	4000	6000	2620	3940	5250	7870	5000	6670	10000	12380	15020	17900
22	1910	2870	3820	5740	2510	3760	5010	7520	4770	6360	9550	11820	14330	17090
23	1830	2750	3670	5500	2400	3590	4790	7190	4570	6090	9130	11300	13720	16340
24	1760	2630	3510	5270	2300	3450	4600	6890	4370	5830	8750	10840	13140	15670
25	1680	2520	3360	5040	2210	3310	4410	6620	4200	5600	8400	10400	12610	15040
26	1620	2420	3230	4850	2120	3180	4240	6360	4040	5380	8080	10000	12130	14470
27	1560	2340	3120	4680	2040	3060	4080	6130	3890	5180	7780	9630	11680	13930
28	1500	2250	3000	4500	1970	2950	3940	5900	3750	5000	7500	9290	11260	13430
29	1450	2170	2900	4340	1900	2850	3800	5700	3620	4830	7240	8960	10870	12980
30	1400	2100	2800	4200	1840	2760	3680	5510	3500	4670	7000	8660	10510	12530

To obtain the safe load concentrated at the center of a beam, divide the safe load given in the above table by two.

If it is required to obtain the safe load using any other fiber stress, multiply the total uniform load on the beam by the extreme fiber stress used in the table and divide this product by the required extreme fiber stress. The beam required to support the load thus obtained may be read directly from the table. A beam having a span of 10 feet, supporting a total uniform load of 2400 pounds, at an extreme fiber stress of 800 pounds per square inch is determined as follows:

$$2400 \times \frac{1000}{800} = 3000$$

From the table a load of 3000 pounds on a 10 foot span requires a 2×12.

TABLE 57

SAFE BENDING MOMENTS IN FOOT POUNDS FOR BEAMS 1″ THICK

Based on actual depth of ¼ inch less than nominal depth, or a 4-inch beam is reduced in value to 3¾ inches

Safe Extreme Fiber Stress in # per Sq. In.	Nominal Depth of Beam.													
	4	5	6	7	8	9	10	12	14	16	18	20	22	24
600	117	188	276	380	501	638	792	1151	1576	2067	2626	3251	3942	4701
700	137	219	321	443	584	744	924	1342	1838	2412	3063	3792	4599	5484
750	146	235	344	475	626	798	990	1438	1969	2584	3282	4063	4928	5876
800	156	251	367	506	667	851	1056	1534	2101	2756	3501	4334	5256	6267
1000	195	313	459	633	834	1063	1320	1918	2626	3445	4376	5418	6570	7834
1100	215	345	505	696	918	1170	1452	2109	2888	3790	4813	5959	7227	8618
1200	234	376	551	759	1001	1276	1584	2301	3151	4134	5251	6501	7884	9401

Example. Given a bending moment of 7200 foot-pounds, it is required to find the depth of a Southern Pine beam of 2 inches thickness to safely sustain this bending. Safe extreme fiber stress of Southern Pine is 1200 pounds per square inch. $7200 \div 2 = 3600$, which is the required bending moment for beam of 1 inch thickness. Opposite 1200 in the above table under 16 inch depth, we obtain 4134, which is the next higher value. Therefore a 2×16 is safe, if determined by extreme fiber stress.

TABLE 58

BENDING MOMENTS IN FOOT-POUNDS

For the following uniform loads, the joists being spaced 24 inches centers

Span in Ft.	Load in Pounds per Square Foot.															
	15	20	25	30	40	50	60	70	75	80	100	125	150	175	200	250
4	60	80	100	120	160	200	240	280	300	320	400	500	600	700	800	1000
5	94	125	156	188	250	313	375	438	469	500	625	781	938	1094	1250	1563
6	135	180	225	270	360	450	540	630	675	720	900	1125	1350	1575	1800	2250
7	184	245	306	368	490	613	735	858	919	980	1225	1531	1840	2144	2450	3060
8	240	320	400	480	640	800	960	1120	1200	1280	1600	2000	2400	2800	3200	4000
9	304	405	506	608	810	1013	1215	1418	1519	1620	2025	2531	3038	3544	4050	5063
10	375	500	625	750	1000	1250	1500	1750	1875	2000	2500	3125	3750	4375	5000	6250
11	454	605	756	908	1210	1513	1815	2118	2269	2420	3025	3781	4538	5294	6050	7563
12	540	720	900	1080	1440	1800	2160	2520	2700	2880	3600	4500	5400	6300	7200	9000
13	634	845	1056	1268	1690	2113	2535	2958	3169	3380	4225	5281	6338	7394	8450	10563
14	735	980	1225	1470	1960	2450	2940	3430	3675	3920	4900	6125	7350	8575	9800	12250
15	844	1125	1406	1688	2250	2813	3375	3938	4219	4500	5625	7031	8438	9844	11250	14063
16	960	1280	1600	1920	2560	3200	3840	4480	4800	5120	6400	8000	9600	11200	12800	16000
17	1084	1445	1806	2168	2890	3613	4335	5058	5419	5780	7225	9031	10838	12644	14450	18063
18	1215	1620	2025	2430	3240	4050	4860	5670	6075	6480	8100	10125	12150	14175	16200	20250
19	1354	1805	2256	2708	3610	4513	5415	6318	6769	7220	9025	11281	13538	15794	18050	22563
20	1500	2000	2500	3000	4000	5000	6000	7000	7500	8000	10000	12500	15000	17500	20000	25000
21	1654	2205	2756	3308	4410	5513	6615	7718	8269	8820	11025	13781	16538	19294	22050	27563
22	1815	2420	3025	3630	4840	6050	7260	8470	9075	9680	12100	15125	18150	21175	24200	30250
23	1984	2645	3306	3968	5290	6613	7935	9258	9919	10580	13225	16531	19838	23144	26450	33063
24	2160	2880	3600	4320	5760	7200	8640	10080	10800	11520	14400	18000	21600	25200	28800	36000
25	2344	3125	3906	4688	6250	7813	9375	10938	11719	12500	15625	19531	23438	27344	31250	39063
26	2535	3380	4225	5070	6760	8450	10140	11830	12675	13520	16900	21125	25350	29575	33800	42250
27	2734	3645	4556	5468	7290	9113	10935	12758	13669	14580	18225	22781	27338	31894	36450	45563
28	2940	3920	4900	5880	7840	9800	11760	13720	14700	15680	19600	24500	29400	34300	39200	49000
29	3154	4205	5256	6308	8410	10513	12615	14718	15769	16820	21025	26281	31538	36794	42050	52563
30	3375	4500	5625	6750	9000	11250	13500	15750	16875	18000	22500	28125	33750	39375	45000	56250

Example. Given a beam supporting a uniform load of 50 pounds per square foot, having a span of 16 feet, spaced 4 feet 6 inches centers, it is required to find the bending moment in foot-pounds. From the above table for 16 foot span and 50 pounds per square foot with beams spaced 2 feet centers, we have 3200 foot-pounds. For 4 feet 6 inches centers the bending moment is $54 \div 24 \times 3200 = 7200$ foot-pounds.

THICKNESS OF WOOD FLOORING

Based on a safe extreme fiber stress of 1000 pounds per square inch, the flooring assumed in simple spans. To the thickness given below add ¼″ to obtain the nominal thickness.

Span in Inches.	Uniform Load in Pounds per Square Foot.															
	15	20	25	30	40	50	60	70	75	80	100	125	150	175	200	250
12	.11	.12	.14	.15	.17	.19	.21	.23	.24	.25	.27	.31	.34	.36	.39	.43
16	.14	.16	.18	.20	.23	.26	.28	.31	.32	.33	.37	.41	.45	.48	.52	.58
18	.16	.18	.21	.23	.26	.29	.32	.34	.36	.37	.41	.46	.50	.54	.58	.65
24	.21	.25	.27	.30	.35	.39	.42	.46	.47	.49	.55	.61	.67	.72	.77	.87
30	.27	.31	.34	.38	.43	.48	.53	.57	.59	.61	.68	.77	.84	.91	.97	1.08
36	.32	.37	.41	.45	.52	.58	.64	.69	.71	.73	.82	.92	1.01	1.09	1.16	1.30
42	.37	.43	.48	.53	.61	.68	.74	.80	.83	.86	.96	1.07	1.17	1.27	1.36	1.52
48	.42	.49	.55	.60	.69	.77	.85	.92	.95	.98	1.10	1.22	1.34	1.45	1.55	1.73
60	.53	.61	.68	.75	.87	.97	1.06	1.15	1.19	1.22	1.37	1.53	1.68	1.81	1.94	2.17
72	.64	.73	.82	.90	1.04	1.16	1.27	1.37	1.42	1.47	1.64	1.84	2.01	2.17	2.32	2.60
84	.74	.86	.96	1.05	1.21	1.36	1.48	1.60	1.66	1.71	1.92	2.14	2.35	2.54	2.71	3.03
96	.85	.98	1.10	1.20	1.39	1.55	1.70	1.83	1.90	1.96	2.19	2.45	2.68	2.90	3.10	3.46

To obtain the required thickness for loads concentrated at center of span, divide the concentrated load per foot of width of flooring by one-half of the span in feet; the resulting value is the equivalent uniform load in pounds per square foot.

The above values were obtained from the following formula:

Let h = thickness of flooring in inches,
w = uniform load in pounds per square foot,
l = simple span in inches,
R = safe extreme fiber stress in pounds per square inch = 1000 in above table.

Then $$h = \sqrt{\frac{l^2 w}{192000}}.$$